Fuel Economy in Harris County
2002, 2007 and 2009

By

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Houston-Galveston Area Council

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Abstract
Due to the fact that taxpayers are only required to report their sales of diesel and gasoline fuel on a statewide basis when they file their Texas Fuel Tax Report, the comptroller receives one fuel tax report per company that includes all their sales in Texas. This includes large companies such as Exxon-Mobil, Shell, B.P., Citgo, etc, as well as medium and small suppliers. The comptroller has neither data nor any way to compile the data, on motor fuel sales in any specific county or city in the state. This lack of real data, prompted Mayor Bill White's office from the City of Houston to contact the Houston-Galveston Area Council to do a regional fuel economy study for the year 2007. This study's aim was to determine how much fuel was being consumed daily by time of day, vehicle type, and roadway type, and to better understand the region's fuel economy and travel pattern characteristics.
Due to the success of our first Fuel Economy Study for 2007, the Houston-Galveston Area Council was contacted by Mayor Bill White's office again to expand the study using a historical and a future year to be able to determine a trend. The years that were selected were 2002 and 2009 respectively.

From our results we can conclude the following:

- On an average weekday, approximately 5,000,000 gallons of fuel is consumed in Houston.
- Gasoline consumption is approximately four times more than diesel consumption.
- Light duty gasoline vehicles clearly dominate the VMT and the fuel consumption.
- The fuel economy is almost constant during the day, with the best occurring during peak periods and the worst during midday. These facts are primarily due to changes in the proportion of heavy duty and light duty traffic volumes.
- Diesel traffic tends to be highest on collectors, while gasoline vehicles tend to travel the most on freeways.
- The overall fuel economy improved from 2002 to 2007 by 1.1% due to fleet turnover and an increase in number of LDG vehicles of 1%.
- The VMT increased by 10% between 2002 and 2007, which shows an increment of 2% per year.
- The total daily fuel consumption increased by 9% from 2002 to 2007 due to the increase in VMT since the increase in fuel economy is almost negligible.
- The plots for hourly VMT and fuel economy for 2002 and 2009 follow the same pattern as for 2007.
- The overall fuel economy has improved by 0.17% between 2007 and 2009 due to the fleet turn over and increased by 1 % for LDG and decreased by 1% for HDD vehicles.
- The VMT has increased by 9.1% between 2007 and 2009, which shows an increment of 4.5% per year due mainly to the opening of a major facility like Interstate-10.
- The total daily fuel consumption increased by 8.9% due to the increased in VMT since the increase in fuel economy is almost negligible.

Further Conclusions and Recommendations:
The study shows that the effect of fleet turn over on fuel economy is almost negligible due to the fact that the CAFÉ (Corporate Average Fuel Economy) standards have not changed for about 20 years. Between the years 2002 and 2007 the VMT and fuel consumption increased at an average

of 2% per year, while between 2007 and 2009 the increase is about 4.5% per year, which gives a total average increase in VMT and fuel consumption of about 3% per year.
Due to these facts, and in order to decrease the fuel consumption, we recommend accelerating the implementation of new CAFÉ standards to 2010 instead of 2020 and making them at least 40 mpg based on different sources of information like[1]:

- The Union of Concerned Scientists, in Washington, DC, projects that the savings that will bring the new CAFÉ standard will be largely negated in 2020 by increased driving.

- Reports by the U.S. National Academy of Sciences[2], think tanks, and activists show that a combination of existing efficiency options, such as continuously variable transmissions and better tires, can cheaply and easily deliver a 35-miles-per-gallon fleet. (See "Why Not a 40-MPG SUV?")[3]

- Europe currently requires 40 miles per gallon average fuel economy and will soon push up to 49 miles per gallon, while Japan is expected to reach 47 miles per gallon in its 2015 standard.

- California officials estimated that the state standard would yield 35 miles per gallon from new cars by about 2016--four years ahead of CAFE.[4]

Other recommendations are:

- Aggressive implementation of transit
- Hybrid vehicles
- Commute solution programs
  Moving more freight by rail to replace trucks when possible throughout our region

Fuel Economy in Harris County
Year 2007

By
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Houston-Galveston Area Council
November, 2007

Introduction

Due to the fact that taxpayers are only required to report their sales of diesel and gasoline fuel on a statewide basis when they file their Texas Fuel Tax Report, the comptroller receives one fuel tax report per company that includes all their sales in Texas. This includes large companies such as Exxon-Mobil, Shell, B.P., Citgo, etc, as well as medium and small suppliers. The comptroller has neither data nor any way to compile the data, on motor fuel sales in any specific county or city in the state. [1] This lack of real data, prompted Mayor Bill White's office from the City of Houston to contact the Houston-Galveston Area Council to do a regional fuel economy study for the year 2007. This study's aim was to determine how much fuel was being consumed daily by time of day, vehicle type, and roadway type, and to better understand the region's fuel economy and travel pattern characteristics.

Calculation Methodology

In order to obtain the necessary data, existing parameters and modeling output were further processed to generate vehicle miles traveled (VMT), average fuel economy (miles/gallon), and total fuel consumption (gallons) in the format requested.

Specifically, for these calculations we used the 2006 Harris county registration distribution from TxDOT, 2006 regional diesel fractions from TTI, 2007 VMT mix data provided by TTI, MOBILE6.2[2] (MOBILE6) default miles per gallon data from EPA, the 2007 vehicle miles traveled per hour per roadway type per vehicle type (output from IMPSUM62[3] program), and the 2007 network of vehicle miles traveled per link per hour (output from the TRANSVMTHSPDWKD[4] program) with data provided by H-GAC. Please refer to Appendix A for definitions on what all these parameters and programs are, and to Appendix B for the input data used.

The registration distribution is represented originally by an array of 16 composite vehicle classes, which aggregate the gasoline and diesel categories over a 25 year period. The registration distribution needed to be split into diesel and gasoline vehicles using the diesel sales fractions in order to be consistent with the data contained in the MOBILE6 fuel economy matrix. Table 1 shows the 28 disaggregated MOBILE6 vehicle classes according to gross vehicle weight. Table 2 shows the relation between the 16 composite vehicle classes in the registration distribution and the disaggregated vehicle classes.

Table 1: MOBILE6 Disaggregated Vehicle Classifications		
Number	***Abbreviation***	***Description***
1	LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)
2	LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, greater than 5,751 lbs.
6	HDGV2b	Class 2b Heavy-Duty Gasoline Vehicles (8,501-10,000 lbs. GVWR)
7	HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
8	HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
9	HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
10	HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
11	HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
12	HDGV8a	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
13	HDGV8b	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
14	LDDV	Light-Duty Diesel Vehicles (Passenger Cars)
15	LDDT12	Light-Duty Diesel Trucks 1and 2 (0-6,000 lbs. GVWR)
16	HDDV2b	Class 2b Heavy-Duty Diesel Vehicles (8,501-10,000 lbs. GVWR)
17	HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
18	HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
19	HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
20	HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
21	HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)
22	HDDV8a	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
23	HDDV8b	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
24	MC	Motorcycles (Gasoline)
25	HDGB	Gasoline Buses (School, Transit and Urban)
26	HDDBT	Diesel Transit and Urban Buses
27	HDDBS	Diesel School Buses
28	LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

Table 2: Relation between the 16 composite and the 28 disaggregated vehicle classes

Composite MOBILE6 Vehicle Classes	Disaggregated MOBILE6 Vehicle Classes
LDV	LDGV, LDDV
LDT1	LDGT1, LDDT1
LDT2	LDGT2, LDDT2
LDT3	LDGT3, LDDT3
LDT4	LDGT4, LDDT4
HDV2b	HDGV2b, HDDV2b
HDV3	HDGV3, HDDV3
HDV4	HDGV4, HDDV4
HDV5	HDGV5, HDDV5
HDV6	HDGV6, HDDV6
HDV7	HDGV7, HDDV7
HDV8a	HDGV8a, HDDV8a
HDV8b	HDGV8b, HDDV8b
HDBS	HDGBS, HDDBS
HDBT	HDBT
MC	MC

The split of the 16 composite vehicle categories was done as in the following example for light duty gasoline and diesel vehicles:

$$Reg\_Dist_{LDGV} = Reg\_Dist_{LDV} \times (1 - Diesel\_Fraction_{LDV})$$

$$Reg\_Dist\ LDDV = Reg\_Dist_{LDV} \times Diesel\_Fraction_{LDV}$$

This calculation was done for all the vehicle categories except for motorcycles (MC) that are considered all gasoline and for heavy duty transit buses that are considered all diesel-fueled. In these two cases their registration distribution was used directly.

Since all these data are represented in arrays, the calculations involve matrix operations. The following equations show how the calculations were made; the numbers in parentheses show the matrix dimensions:

$$\underset{(25x28)}{\{ A \}} \times \underset{(28x15)}{\{ B \}|_{am,\ md,\ pm,\ ov}} = \underset{(25x15)}{\{ C \}|_{am,\ md,\ pm,\ ov}} \quad \text{equation 1}$$

$$\underset{(15x25)}{\{ C \}^t|_{am,md,pm,ov}} \times \underset{(25x28)}{\{ D \}} = \underset{(15x28)}{\{ E \}|_{am,\ md,\ pm,\ ov}} \quad \text{equation 2}$$

Where the matrix descriptions are the following:

{ A } = matrix of registration distributions, (25x28), which represents the percentage of the 28 different vehicle types for a 25 year distribution.

{ B } = matrix of VMT mix, (28x15), which represents the percentage of the 28 different vehicle types on the 15 types of roads (facility types) from the travel demand model for each time period: morning peak(am peak), midday (md), afternoon peak (pm), and overnight peak (ov). The 15 facility types are the following: urban interstate, urban other freeway, toll roads, ramps, urban principal arterial, urban other arterial, urban collector, local-centroid connector, rural interstate, rural other freeway, rural principal arterial, rural other arterial, rural major collector, rural collector, and local-intrazonal. Appendix A has the definitions of these facility types.

The four time periods are defined as follows:

A.M. Peak: 6:01 am – 9:00 a.m.
Midday: 9:01 a.m. – 3:00 p.m.
P.M. Peak: 3:01 p.m. – 7:00 p.m.
Overnight: 7:01 p.m. – 6:00 a.m.

{ C } = this matrix represents the weighting average of all vehicle types for the 25 years distribution on each facility type for each time period, (25 x 15).

$\{ C \}^t$ = the transpose of matrix C, (15 x 25).

{ D } = Fuel economy matrix, (25x28), which represents the miles per gallon (mpg) used for each of the 28 different vehicle types for each of the 25 years distribution, from 1983 to 2007. Please note that the original fuel economy matrix, from 1952 to 2050, had to be cut to be able to use a 25 year distribution.

{ E } = this matrix (15x28) represents the fuel economy weighting average over the 25 years distribution for the 28 vehicle types on the 15 facility types.

Equation 1 represents the matrix multiplication of the Harris county registration distribution times the VMT matrix to get matrix C, the weighted average of all vehicle types for the 25 years distribution on each facility type for each time period. Then, in equation 2, the transpose of matrix C is multiplied by the fuel economy matrix to get matrix E, which represents the fuel economy age weighting average for the 28 different vehicle types on the fifteen different facility types used

in the MOBILE6 program for the four time periods. These calculations are done 4 times, one for each time period.

Results and Discussion

VMT & Fuel Consumption by Time Period

The results from each element of the { E } matrix were inverted and then multiplied by the hourly VMT (vehicle miles traveled) output from the IMPSUM program to calculate the total fuel consumption for each of the 28 vehicle category types for each of the road types for each hour of the day. Then, the fuel consumption results were aggregated into gasoline vehicles and diesel vehicles for presentation clarity. Please refer to Table 3 for 2007 hourly and daily total VMT, fuel consumption according to fuel type, and fuel economy (where the fuel economy was calculated as the ratio of vehicle miles traveled versus gallons of fuel consumed). This table shows that the total daily fuel consumption for the year 2007 is 5,365,554 gallons in Harris County alone. Also, it is evident that gasoline consumption is more than four times that of diesel consumption.

Table 3: 2007 Hourly and Daily Total VMT, Fuel Consumption and Fuel Economy

By Hour	VMT (miles)	Gas (gallons)	Diesel (gallons)	Fuel (gallons)	Fuel Economy (miles/gallon)
12:00 AM	642,652.60	28,835.00	6,621.86	35,456.87	18.12491304
1:00 AM	425,981.40	19,113.25	4,389.33	23,502.58	18.12488179
2:00 AM	391,427.00	17,562.75	4,033.32	21,596.07	18.12492218
3:00 AM	371,976.40	16,690.01	3,832.83	20,522.84	18.12499831
4:00 AM	630,885.70	28,306.98	6,500.70	34,807.68	18.12490014
5:00 AM	1,979,662.80	88,825.02	20,398.42	109,223.44	18.12488956
6:00 AM	6,936,735.60	315,635.00	61,297.60	376,932.60	18.40311913
7:00 AM	8,162,231.70	371,397.52	72,126.88	443,524.40	18.40311744
8:00 AM	6,739,251.70	306,649.10	59,552.58	366,201.68	18.40311511
9:00 AM	4,318,154.30	191,704.78	62,389.05	254,093.84	16.99432906
10:00 AM	4,194,602.00	186,219.67	60,603.97	246,823.65	16.99432798
11:00 AM	4,404,710.30	195,547.47	63,639.63	259,187.09	16.99432734
12:00 PM	4,566,049.80	202,710.15	65,970.69	268,680.84	16.99432611
1:00 PM	4,689,193.80	208,177.13	67,749.75	275,926.88	16.99433464
2:00 PM	5,011,654.70	222,492.80	72,408.78	294,901.57	16.9943301
3:00 PM	7,609,070.60	347,951.44	61,125.49	409,076.93	18.60058594
4:00 PM	8,442,372.70	386,057.08	67,819.51	453,876.59	18.60059085
5:00 PM	9,015,676.20	412,273.41	72,425.00	484,698.41	18.60058964
6:00 PM	7,266,495.90	332,286.02	58,373.52	390,659.54	18.60058463
7:00 PM	3,242,030.00	145,465.75	33,406.05	178,871.80	18.1248804
8:00 PM	2,545,525.20	114,214.50	26,229.25	140,443.75	18.12487395
9:00 PM	2,180,939.80	97,855.96	22,472.52	120,328.48	18.1248843
10:00 PM	1,689,400.40	75,801.26	17,407.72	93,208.99	18.12486598
11:00 PM	1,141,997.30	51,239.95	11,767.16	63,007.11	18.12489511
Daily Total	96,598,678	4,363,012	1,002,542	5,365,554	18

Figure 1 shows a plot of 2007 hourly VMT and fuel economy for a typical weekday. From this plot we can observe that the fuel economy is very similar for all hours of the day with the best average fuel economy occurring during the morning and afternoon peak periods and the worst at midday. To analyze the reason behind these fuel economy results, we have tabulated the VMT mix for arterials, collectors and freeways for the four time periods and the four aggregated vehicle groups, shown in Tables 4-7.

Figure 1: 2007 Hourly VMT and Fuel Economy

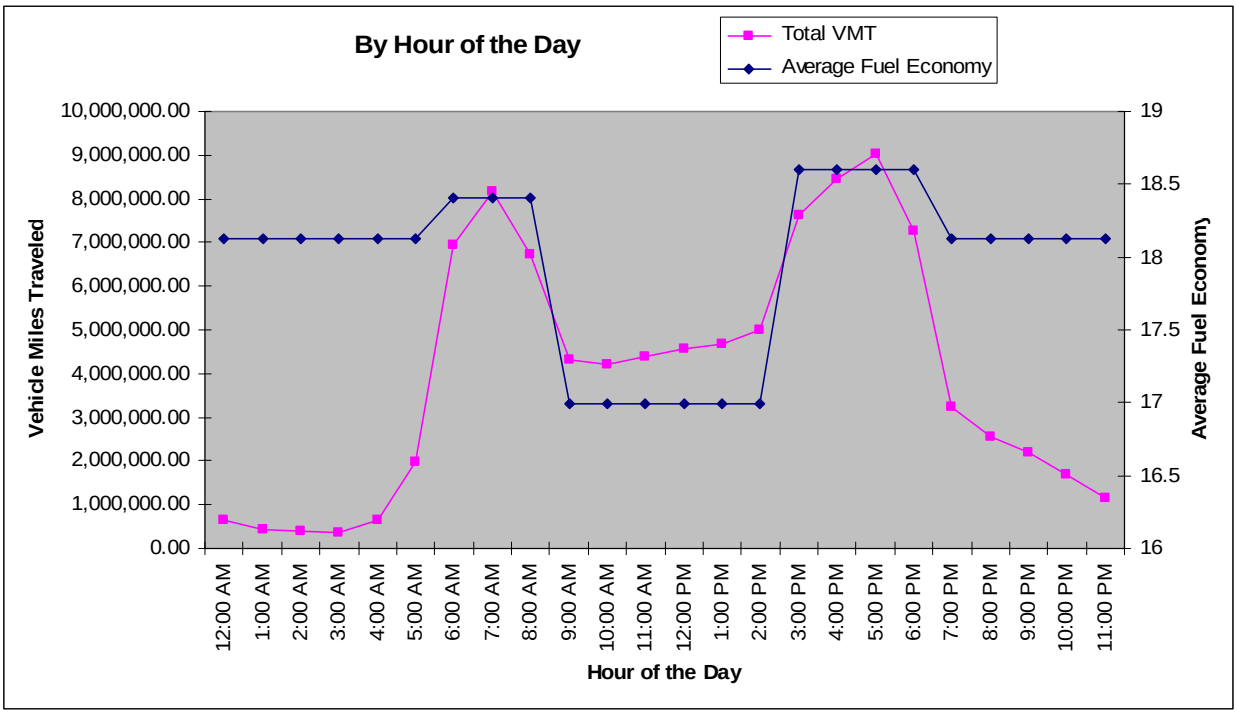


Table 4: 2007 VMT Percentage for the Morning Period

	LDG	LDD	HDG	HDD
Freeways	94%	0%	1%	5%
Arterials	92%	0%	1%	6%
Collectors	86%	0%	2%	12%

Table 5: 2007 VMT Percentage for the Midday Period

	LDG	LDD	HDG	HDD
Freeways	89%	0%	1%	9%
Arterials	87%	0%	2%	11%
Collectors	83%	0%	3%	15%

Table 6: 2007 VMT Percentage for the Afternoon Period on Selected Vehicles

	LDG	LDD	HDG	HDD
Freeways	94%	0%	1%	5%
Arterials	93%	0%	1%	6%
Collectors	89%	0%	2%	9%

Table 7: 2007 VMT Percentage for the Overnight Peak Period

	LDG	LDD	HDG	HDD
Freeways	92%	0%	1%	7%
Arterials	93%	0%	1%	6%
Collectors	90%	0%	1%	8%

From these tables we can observe that the VMT is distributed in roughly the same pattern across all four time periods, with LDG traffic comprising the vast majority of the region's VMT throughout the 24-hour day. However, small differences are evident. During the midday period, heavy duty traffic is at its maximum, while the more fuel efficient light-duty traffic has decreased which likely accounts for most of the decrease in average fuel economy during the midday. It is also apparent that heavy-duty vehicles tend to travel on the region's lower-speed arterials and collectors rather than by freeway, and vice-versa for light-duty vehicles; because most vehicles get better fuel economy in highway driving rather than city driving, and because the light-duty vehicles comprise most of the VMT, this trend likely equates to an increase in overall fuel economy. Also, during the morning and afternoon peak periods, fuel economy is at its highest due to the fact that traffic is dominated by LDG which is also at its highest on the freeways. According to our calculations, differences on vehicle and roadway type dominate the effects on fuel economy rather than changes in congestion levels, perhaps because the travel demand model generally does not capture congestion levels adequately.

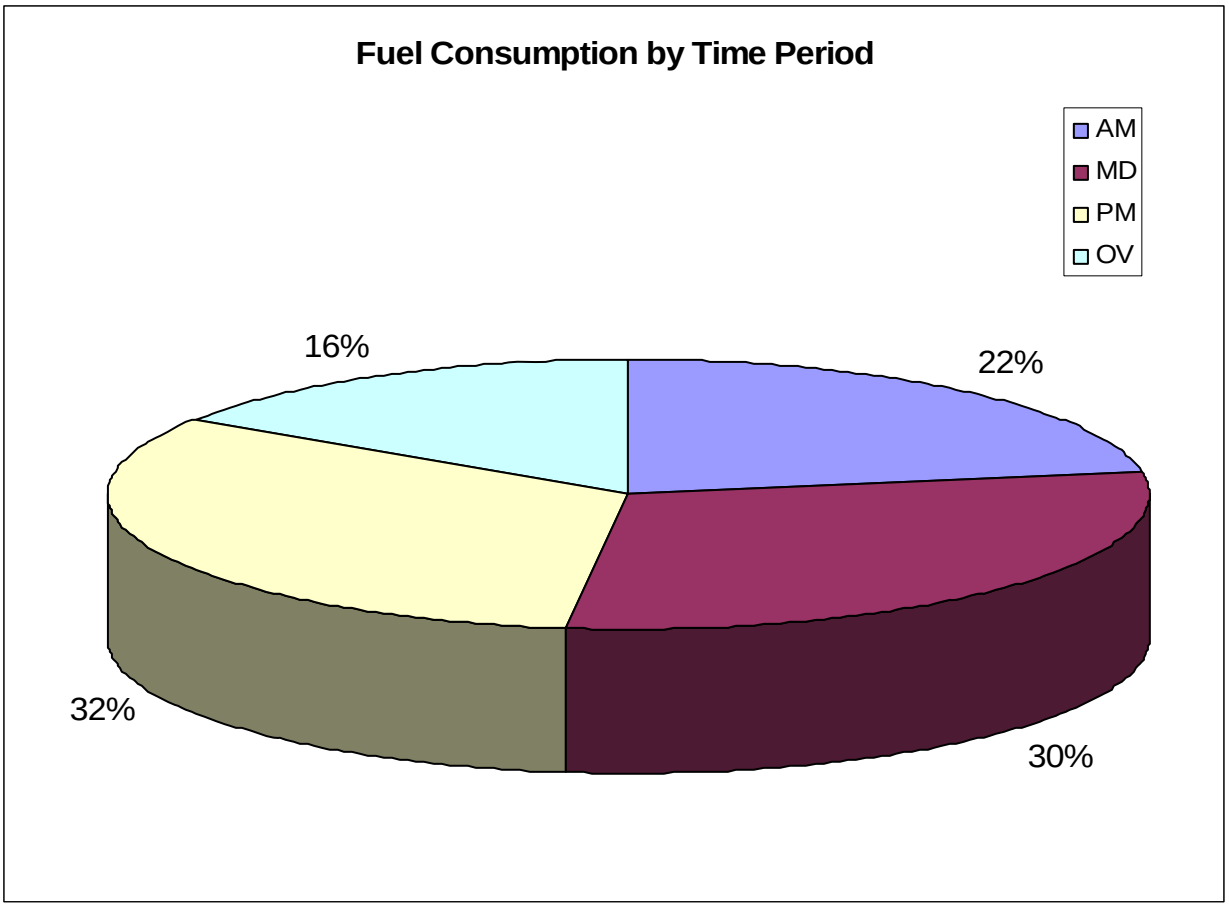
Table 8 shows the 2007 VMT, the fuel consumption, and fuel economy for the four time periods.

Table 8: 2007 Fuel Consumption and Fuel Economy for the four time periods.

	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
AM	21,838,219.00	993,681.62	192,977.07	1,186,658.69	18.40
MD	27,184,364.90	1,206,852.00	392,761.88	1,599,613.88	16.99
PM	32,333,615.40	1,478,567.95	259,743.52	1,738,311.47	18.60
OV	15,242,478.60	683,910.43	157,059.16	840,969.59	18.12

Figure 2 shows the 2007 percentage of daily fuel consumption by time period. From this information, we can observe that the afternoon peak period (PM peak) is the period with the largest total fuel consumption, which is consistent with table 8 since this period has the largest VMT. Table 8 also shows that diesel fuel consumption is highest during the midday period, which is consistent with Figure 1 and Tables 4-7 since the heavy-duty diesel traffic is at its highest during the midday period.

Figure 2: 2007 Daily Fuel Consumption by Time Period



VMT & Fuel Consumption by Roadway Type

Table 9 shows the 2007 daily VMT, gasoline and diesel fuel consumption, and the fuel economy according to the road type classification.

Table 9: 2007 Daily Fuel Consumption and Fuel Economy according to Road Type from IMPSUM output

ROADWAY TYPE	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
URBAN INTERSTATE (Fr)*	10,549,727.60	474,409.14	99,963.04	574,372.18	18.36740685
URBAN OTHER FREEWAY (Fr)	4,326,666.30	194,778.85	40,196.84	234,975.69	18.41325049
TOLL ROADS (Fr)	6,400,886.40	288,263.41	58,926.88	347,190.30	18.43624792
RAMPS (FWY/TOLL/FRNT) (Fr)	576,797.90	26,006.18	5,907.70	31,913.88	18.07357559
URBAN PRIN. ART. (Ar)*	3,076,334.50	139,293.71	31,889.74	171,183.45	17.97098067
URBAN OTHER ART. (Ar)	6,571,472.70	297,584.79	67,835.47	365,420.26	17.98332863
URBAN COLLECTOR (Ar)	386,145.60	17,348.82	5,718.76	23,067.57	16.7397581
LOCAL (CENT.CONN.) (Co)*	7,564,709.50	343,406.35	113,183.97	456,590.32	16.56782699
RURAL INTERSTATE (Fr)	18,148,519.40	816,476.18	170,313.38	986,789.56	18.39147887
RURAL OTHER FREEWAY (Fr)	3,502,039.10	157,631.09	32,601.71	190,232.80	18.40922888
RURAL PRIN. ART. (Ar)	9,813,627.60	444,344.14	101,400.46	545,744.60	17.98208846
RURAL OTHER ART. (Ar)	23,326,864.00	1,056,521.08	239,610.67	1,296,131.75	17.99729383
RURAL MAJOR COL. (Co)	1,335,024.20	60,624.06	19,869.19	80,493.24	16.58554331
RURAL COLLECTOR (Co)	746,246.70	33,902.67	11,032.84	44,935.51	16.60706082
LOCAL (INTRAZONAL) (Co)	273,616.10	12,421.53	4,090.97	16,512.50	16.57024468
Total	96,598,677.60	4,363,012.00	1,002,541.63	5,365,553.63	18.0034875

*Where Fr, Ar and Co means freeway, arterial, and collector respectively.

Table 10 shows the 2007 daily fuel consumption after the road types have been aggregated into freeway, arterial and collector. It is evident from this data that gasoline consumption is more than 4x that of diesel consumption for freeways and arterials, except for collectors, which is closer to 3x. This latter observation is also consistent with earlier observations in which there is a higher proportion of HDD traffic on collectors than other road types.

Table 10: 2007 Daily Fuel Consumption and Fuel Economy for each of the aggregated roadway types

	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
Freeway	43,504,636.70	1,957,564.86	407,909.56	2,365,474.41	18.39
Arterial	43,174,444.40	1,955,092.54	446,455.10	2,401,547.64	17.98
Collector	9,919,596.50	450,354.61	148,176.97	598,531.57	16.57

Figure 3 shows the 2007 percentage of daily fuel consumption for the aggregated roadway types.

Figure 3: 2007 Daily Fuel Consumption by Roadway Type

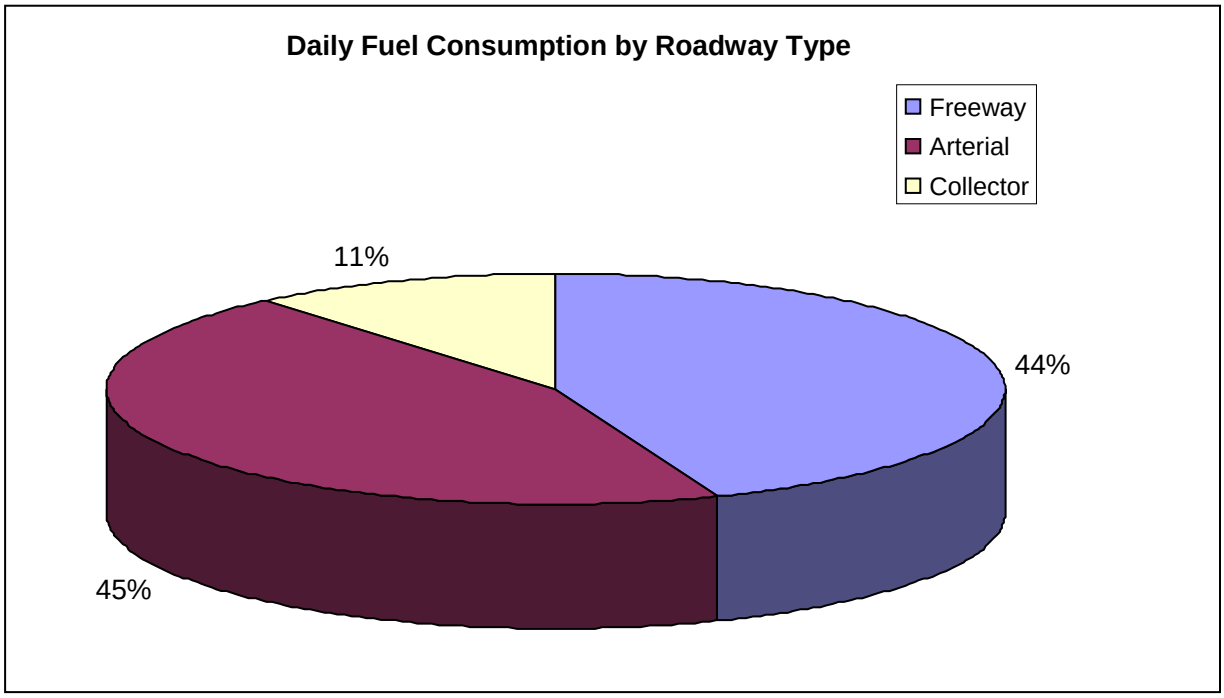
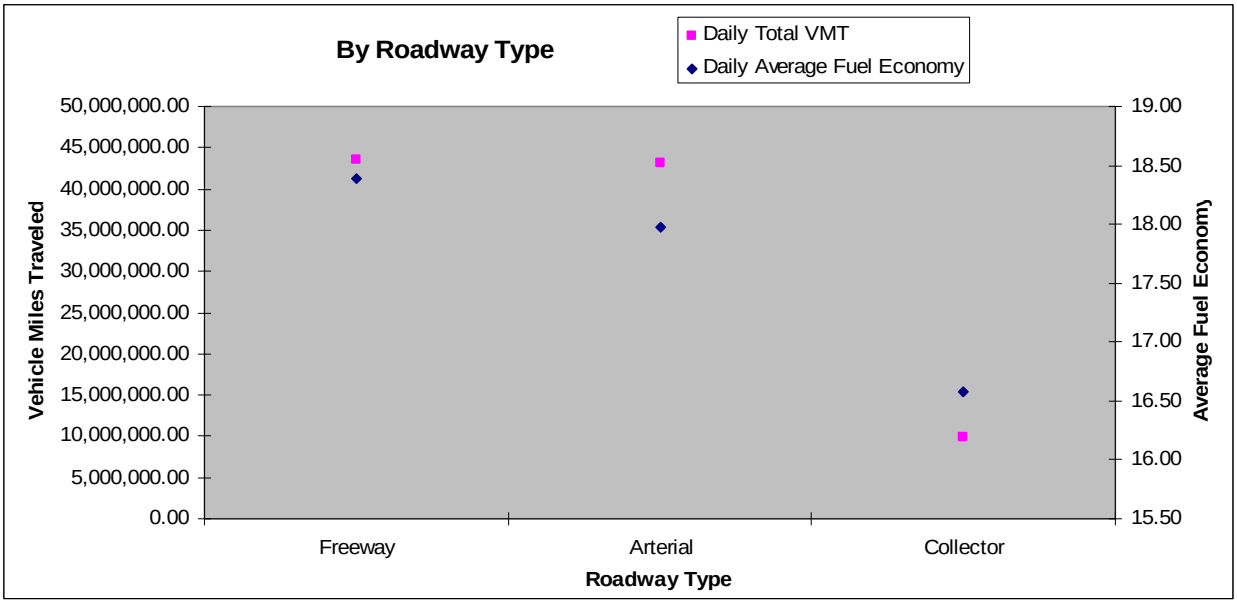


Figure 4 shows the 2007 daily VMT and average fuel economy by roadway type. The lower average fuel economy observed on the collector can be attributed to the higher proportions of HDD traffic.

Figure 4: 2007 Daily VMT and Fuel Economy by Roadway Type



VMT & Fuel Consumption by Vehicle Type

Table 11 shows the 2007 daily vehicle miles travel, fuel consumption, and daily fuel economy for each of the 28 vehicles classes. Table 12 shows this information in an aggregated format, where the vehicle types have been aggregated into light duty gas (LDG), heavy duty gas (HDG), light duty diesel (LDD), and heavy duty diesel (HDD) vehicles.

Table 11: 2007 Daily Fuel consumption for each of the 28 EPA's vehicle classifications

Vehicle Class	VMT (miles)	Gas (gallons)	Diesel (gallons)	Fuel (gallons)	Fuel Economy (miles/gallon)
LDGV	58012845.9	2467837.254	0	2467837.254	23.5075655
LDGT1	5135561.4	281128.2326	0	281128.2326	18.26768288
LDGT2	17095922.1	935856.0825	0	935856.0825	18.26768284
LDGT3	5225791.7	372256.1609	0	372256.1609	14.03816041
LDGT4	2403207.9	171191.0406	0	171191.0406	14.03816398
HDGV2b	655359.5	66910.3672	0	66910.3672	9.794588304
HDGV3	229724.7	25303.86258	0	25303.86258	9.078641622
HDGV4	90958.2	10081.1238	0	10081.1238	9.022625035
HDGV5	32650.2	4203.946174	0	4203.946174	7.766559953
HDGV6	88626.9	11285.11468	0	11285.11468	7.853433708
HDGV7	29153.1	4044.97794	0	4044.97794	7.207233373
HDGV8a	33817.9	4949.753818	0	4949.753818	6.832238782
HDGV8b	5829.2	895.3699532	0	895.3699532	6.510381524
LDDV	58243.1	0	1842.690906	1842.690906	31.60763415
LDDT12	3915.7	0	180.8501489	180.8501489	21.65162718
HDDV2b	1398350.6	0	111718.3158	111718.3158	12.51675332
HDDV3	400025.5	0	35523.0158	35523.0158	11.26102306
HDDV4	240016.1	0	24279.95112	24279.95112	9.885361746
HDDV5	170444.7	0	17825.21435	17825.21435	9.562000023
HDDV6	511337.6	0	60557.47342	60557.47342	8.443839729
HDDV7	250451.1	0	34155.57141	34155.57141	7.3326573
HDDV8a	507856.7	0	79747.54268	79747.54268	6.368305316
HDDV8b	3466171.8	0	570533.5099	570533.5099	6.075316769
MC	96598.8	1975.854178	0	1975.854178	48.88964027
HDGB	31989.9	5092.854557	0	5092.854557	6.281329977
HDDBT	111254.1	0	26335.15808	26335.15808	4.224546503
HDDBS	200225.7	0	33096.43675	33096.43675	6.049766068
LDDT34	112347.6	0	6745.899222	6745.899222	16.6542067
Total	96,598,678	4,363,012	1,002,542	5,365,554	18.00

Table 12: 2007 Daily Fuel Consumption by Aggregated Vehicle Classes

By Vehicle Class	**VMT (miles)**	**Gas (gallons)**	**Diesel (gallons)**	**Fuel (gallons)**	**Fuel Economy (miles/gallon)**
LDG	87,969,928	4,230,245	0	4,230,245	21
HDG	1,198,110	132,767	0	132,767	9
LDD	174,506	0	8,769	8,769	20
HDD	7,256,134	0	993,772	993,772	7

Figure 5 shows the percentage of daily fuel consumption according to the aggregated vehicle types for 2007. The fuel consumption is clearly dominated by LDG.

Figure 5: 2007 Daily Fuel Consumption by Vehicle Type

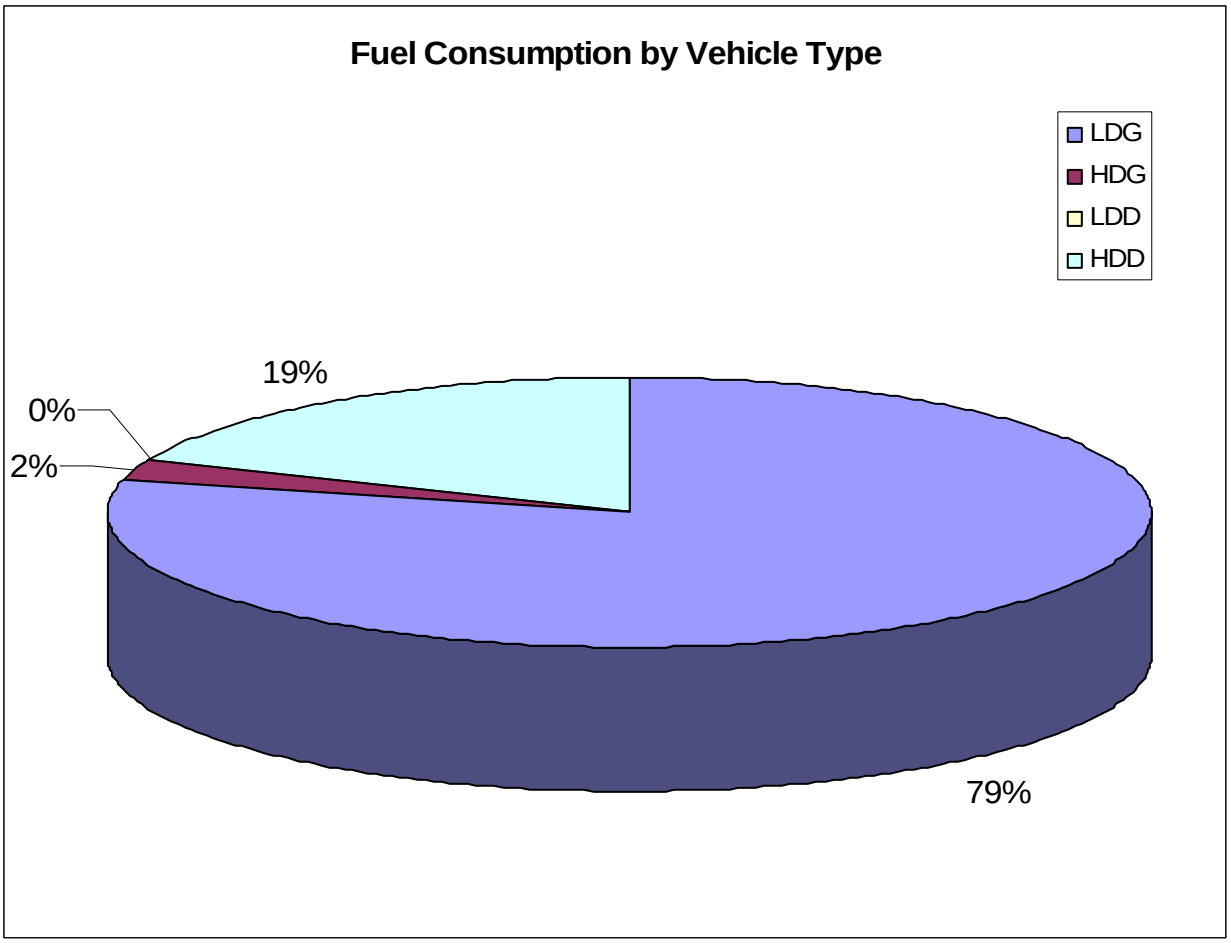
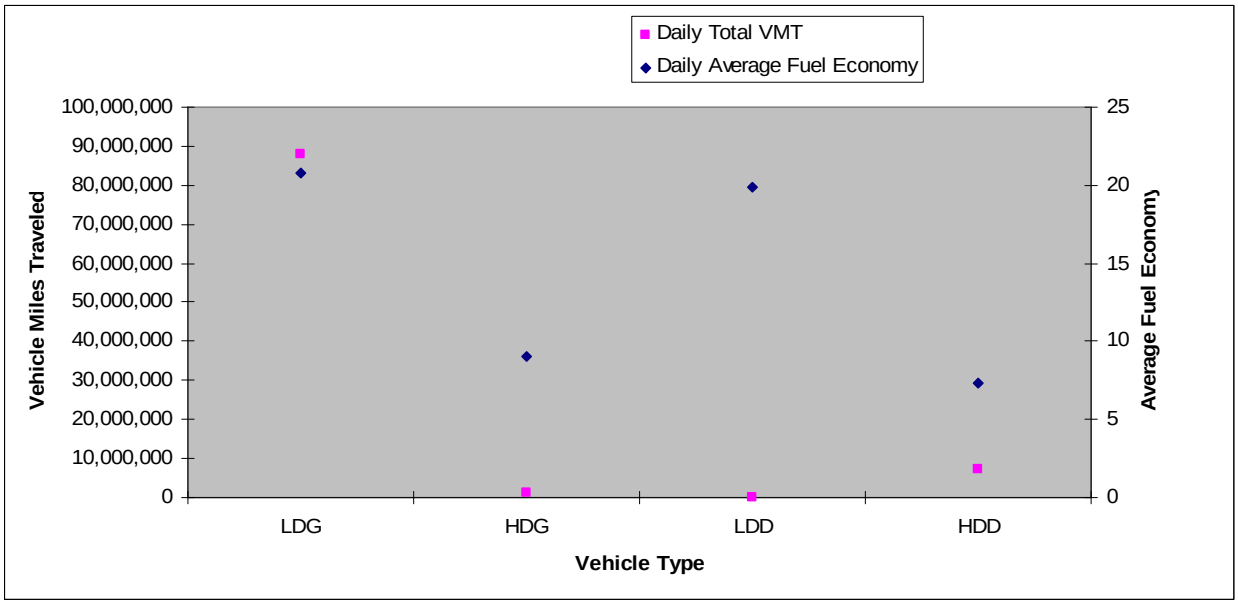


Figure 6 shows a plot of 2007 daily VMT and fuel economy for the aggregated vehicle types for an average weekday, from which we can observe that the LDG vehicles are the ones with the highest VMT and the highest fuel economies.

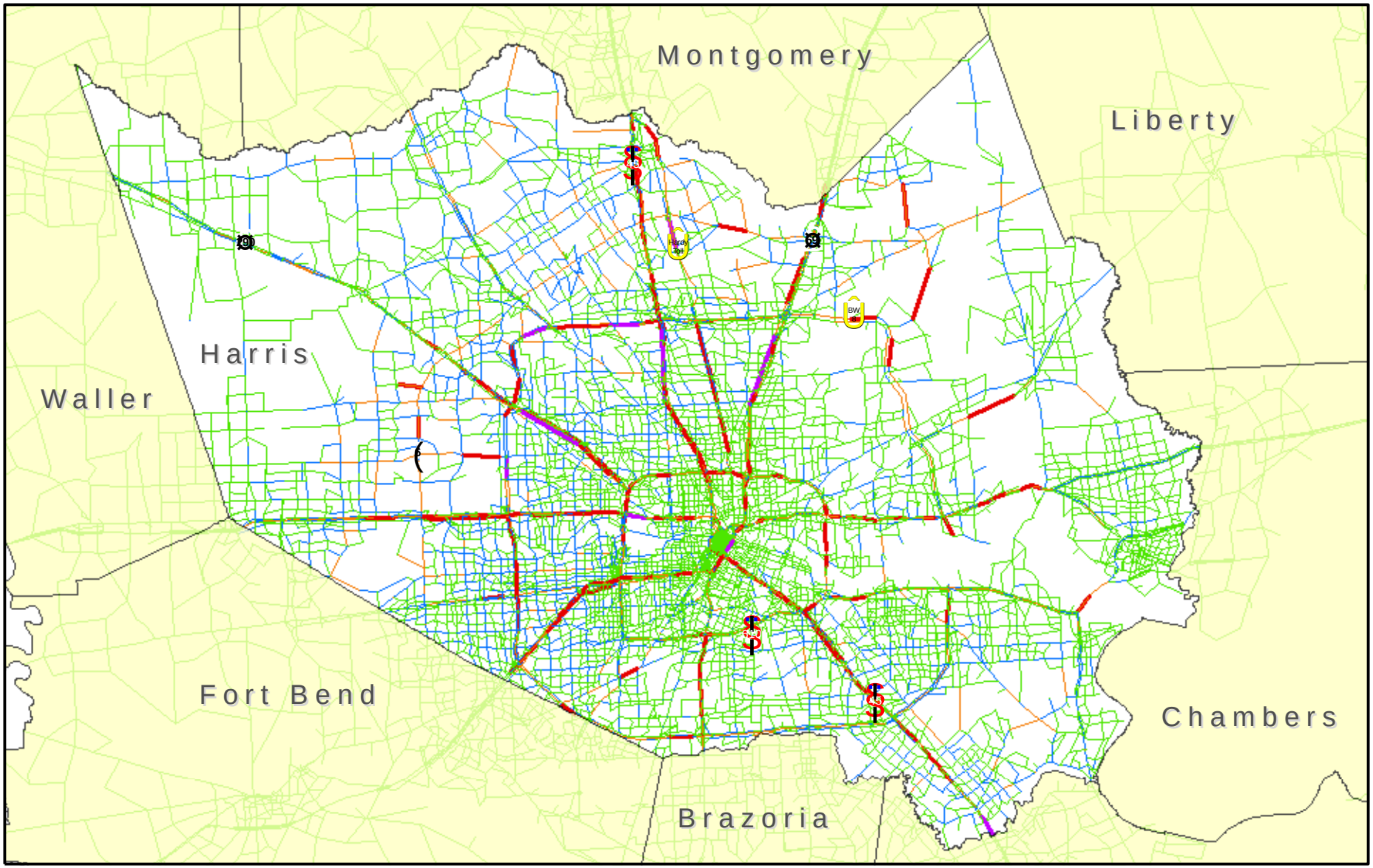
Figure 6: 2007 Daily VMT and Fuel Economy by Aggregated Vehicle Type



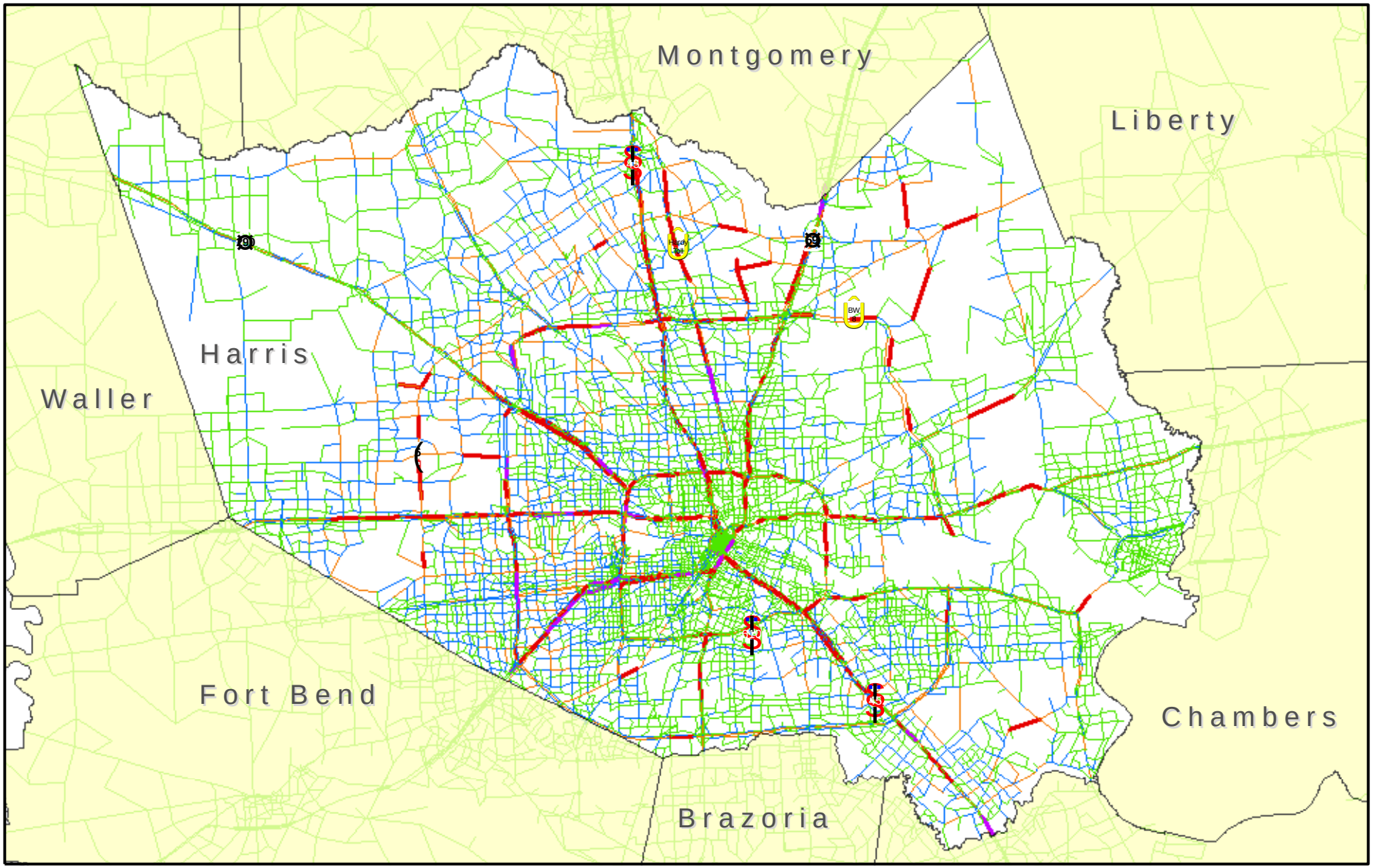
Mapping of Fuel Consumption for 2007

To calculate the fuel consumption per link, we inverted the fuel economy per road type and multiplied it by the 2007 network of vehicle miles traveled for each link (see Appendix A for link definition) to get the total gallons of fuel consumed per link for each time period. The vehicle miles traveled per link per hour is the output from the TRANSVMTHSPDWKD program, this data is provided by H-GAC. The results were mapped in GIS, and can be seen in the network maps on the following pages.

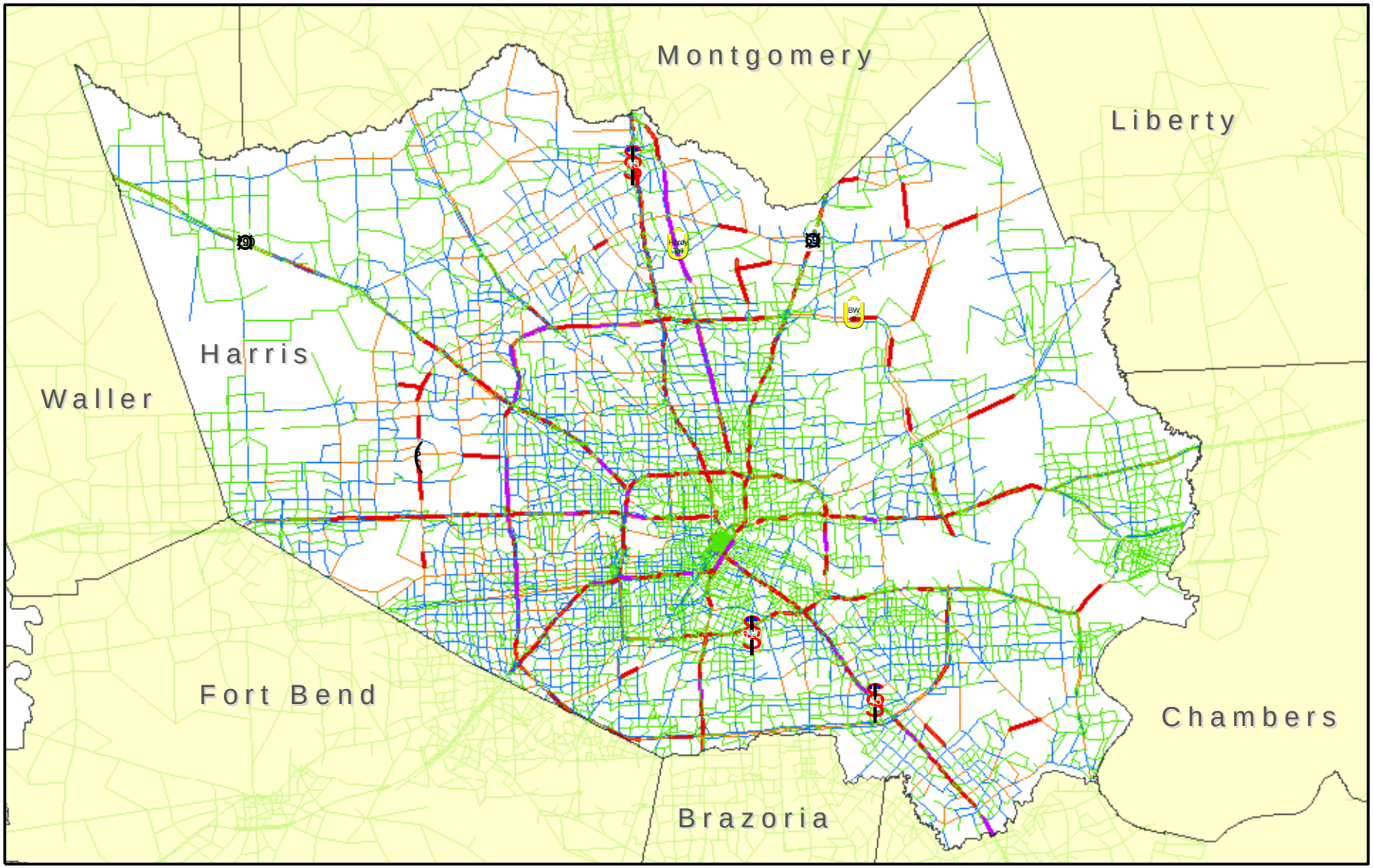
The morning, afternoon, and midday period maps clearly show very high fuel consumption (501-1000 gallons) for most of the highway and principal arterial's links, with some of the links showing consumption greater than 1000 gallons for that time period. As might be expected, the map from the overnight period shows the least fuel consumption. Interestingly, all of the maps show that the highest fuel consumption rates are on the north, west, and northwestern portions of the county. It may also be observed that the highest fuel consumption rates are mostly encompassed within a radius approximately delineated by Highway 6; the notable exceptions to this are I-10 west and I-45 north, which have high fuel consumption rates extending far beyond Highway 6 during all but the overnight period.



Harris County ***Daily Total Gallons*** 0 - 50 Gal 51 - 200 Gal 201 - 500 Gal 501 - 1000 Gal > 1000 Gal	**Fuel Consumption Chart - Morning Period** **Harris County**	– H-GAC Houston-Galveston Area Council

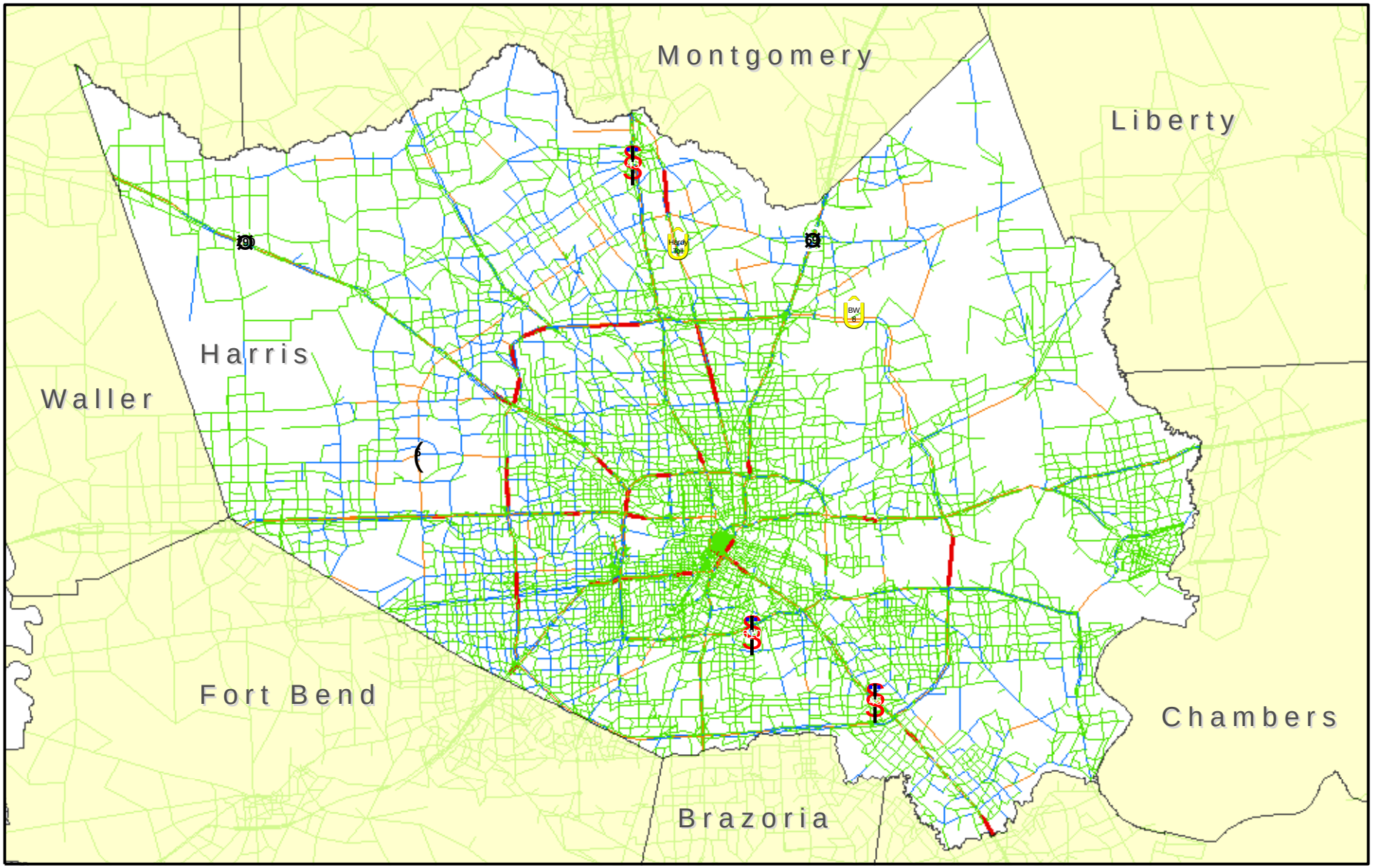


Harris County ***Daily Total Gallons*** 0 - 50 Gal 51 - 200 Gal 201 - 500 Gal 501 - 1000 Gal > 1000 Gal	**Fuel Consumption Chart - Mid-Day Period** **Harris County**	– H-GAC Houston-Galveston Area Council



Harris County ***Daily Total Gallons*** 0 - 50 Gal 51 - 200 Gal 201 - 500 Gal 501 - 1000 Gal > 1000 Gal	**Fuel Consumption Chart - Afternoon Period** **Harris County**	–

H-GAC
Houston-Galveston Area Council



Harris County ***Daily Total Gallons*** 0 - 50 Gal 51 - 200 Gal 201 - 500 Gal 501 - 1000 Gal > 1000 Gal	**Fuel Consumption Chart - Overnight Period** **Harris County**	– H-GAC Houston-Galveston Area Council

Conclusions - 2007

From our results we can conclude the following:

- On an average weekday, approximately 5,000,000 gallons of fuel is consumed in Houston.
- Gasoline consumption is approximately four times more than diesel consumption.
- Light duty gasoline vehicles clearly dominate the VMT and the fuel consumption.
- The fuel economy is almost constant during the day, with the best occurring during peak periods and the worst during midday. These facts are primarily due to changes in the proportion of heavy duty and light duty traffic volumes.
- Diesel traffic tends to be highest on collectors, while gasoline vehicles tend to travel the most on freeways.

Acknowledgments

We will like to thank Dr. Dennis Perkinson from the Texas Transportation Institute for the review of this study, Christine Smith from H-GAC for helping reviewing and setting the spread sheets, and Frank Pagliei and Eric Boulet from H-GAC for the GIS mapping of the fuel consumption.

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Fuel Economy in Harris County
Historical Year Study 2002
Future Year Study 2009

By
Dr. Graciela Lubertino
Houston-Galveston Area Council
March 11, 2008

Introduction

Due to the success of our first Fuel Economy Study for 2007, the Houston-Galveston Area Council has been contacted by Mayor Bill White's office from the City of Houston to expand the study using a historical and a future year, to be able to determine a trend. The years that have been selected are 2002 and 2009 respectively. For these years we have used the same calculation methodology as the previous study.

Results and Discussion – Historical Year 2002

For this study it was used the 2002 Harris county registration distribution provided by TxDOT, the 2002 VMT mix data provided by TTI**,** 2002 diesel fractions provided by TTI, MOBILE6.2 default miles per gallon data from EPA, and the 2002 vehicle miles traveled per hour per roadway type per vehicle type (output from IMPSUM62 program) provided by H-GAC.

a) VMT & Fuel Consumption by Time Period

Table 1 shows the hourly and daily VMT, fuel consumption and fuel economy for 2002, from where we can observe that the fuel economy increased by 1.1% between 2002 and 2007.

Table 1: 2002 Hourly and Daily Total VMT, Fuel Consumption and Fuel Economy

Hour	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
12:00 AM	489,957.60	22,181.21	4,883.23	27,064.44	18.10337221
1:00 AM	321,588.90	14,558.91	3,205.17	17,764.08	18.10332786
2:00 AM	293,016.20	13,265.41	2,920.40	16,185.81	18.10327519
3:00 AM	279,176.00	12,638.78	2,782.43	15,421.20	18.10338891
4:00 AM	480,913.60	21,771.60	4,793.15	26,564.75	18.10345117
5:00 AM	1,531,432.50	69,330.65	15,263.22	84,593.87	18.10335168
6:00 AM	6,864,607.90	314,384.76	59,063.13	373,447.90	18.38170181
7:00 AM	8,017,549.60	367,186.98	68,983.03	436,170.01	18.38170762
8:00 AM	6,607,080.70	302,590.45	56,847.32	359,437.77	18.3817094
9:00 AM	4,386,479.70	198,452.63	64,212.62	262,665.25	16.69988611
10:00 AM	4,231,930.90	191,460.41	61,950.21	253,410.61	16.69989595
11:00 AM	4,424,809.00	200,186.61	64,773.80	264,960.41	16.69988735
12:00 PM	4,567,912.50	206,660.92	66,868.58	273,529.51	16.69988944
1:00 PM	4,693,392.40	212,337.88	68,705.39	281,043.27	16.69989232
2:00 PM	5,015,496.20	226,910.39	73,420.76	300,331.15	16.69988692
3:00 PM	6,432,248.10	297,211.17	51,410.02	348,621.19	18.45053677
4:00 PM	7,207,774.00	333,045.44	57,608.52	390,653.96	18.45053341
5:00 PM	7,788,465.10	359,877.01	62,249.66	422,126.67	18.45054027
6:00 PM	6,195,866.30	286,288.74	49,520.90	335,809.63	18.45053183
7:00 PM	2,407,704.20	109,000.84	23,996.65	132,997.49	18.10338017
8:00 PM	1,880,907.40	85,151.89	18,746.29	103,898.18	18.10337232
9:00 PM	1,606,516.20	72,729.81	16,011.52	88,741.34	18.1033582
10:00 PM	1,196,058.00	54,147.65	11,920.61	66,068.26	18.10336749
11:00 PM	774,822.60	35,077.57	7,722.37	42,799.94	18.10335787
Total	87,695,706	4,006,448	917,859	4,924,307	17.80874167

Figure 1: 2002 Hourly VMT and Fuel Economy

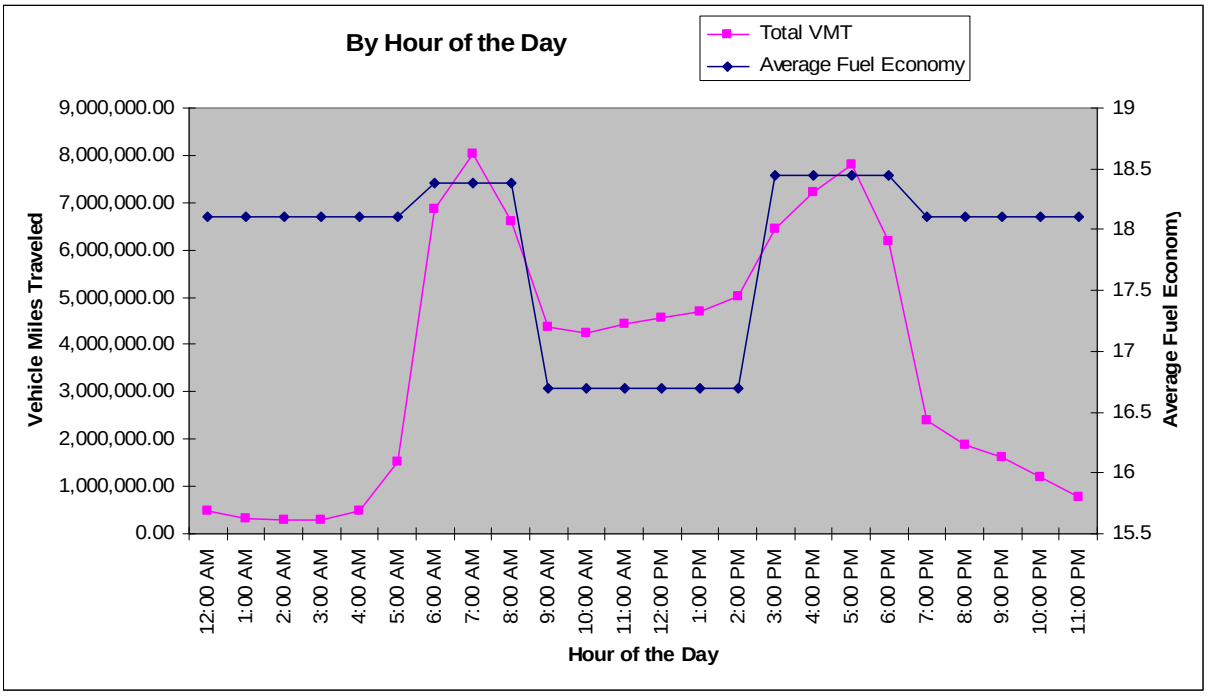


Figure 1 shows the same trend for 2002 as for 2007. Comparing the VMT mix (tables 2-5) for 2002 with the one for 2007, we observed the following:

- an increased by 1% in the number of LDG vehicles for the morning peak period in the freeways from 2002 to 2007.
- a decreased by 1% in the number of HDG vehicles for the morning peak period in the arterials from 2002 to 2007.
- a decreased by 3% in the number of LDG vehicles for the morning peak period in the collectors from 2002 to 2007.
- an increased by 4% in the number of HDD vehicles for the morning peak period in the collectors from 2002 to 2007.
- an increased by 1% in the number of LDG vehicles for the midday period in the freeways from 2002 to 2007.
- a 1% decreased in the number of HDG vehicles for the midday period in the freeways from 2002 to 2007.
- a 1% decreased in the number of HDG vehicles for the midday period in the arterials from 2002 to 2007.
- a 3% decreased in the number of LDG vehicles for the midday period in the collectors from 2002 to 2007.
- A 4% increased in the number of HDD vehicles for the midday period in the collectors from 2002 to 2007.
- A 1% decreased in the number of LDG vehicles for the afternoon period in the freeways from 2002 to 2007.
- A 1% decreased in the number of HDG vehicles for the afternoon period in the arterials from 2002 to 2007.

- A 2% decreased in the number of LDG vehicles for the afternoon period in the collectors from 2002 to 2007
- A 2% increased in the number of HDD vehicles for the afternoon period in the collectors from 2002 to 2007.
- A 1% decreased in the number of LDG vehicles for the overnight period in the freeways from 2002 to 2007
- A 1% increased in the number of LDG vehicles for the overnight period in the arterials from 2002 to 2007
- A 3% decreased in the number of LDG vehicles for the overnight period in the collectors from 2002 to 2007
- A 3% increased in the number of HDD vehicles for the overnight period in the collectors from 2002 to 2007

Table 2: 2002 VMT Percentage for the Morning Period

	LDG	LDD	HDG	HDD
Freeways	93%	0%	1%	5%
Arterials	92%	0%	2%	6%
Collectors	89%	0%	2%	8%

Table 3: 2002 VMT Percentage for the Mid-day Period

	LDG	LDD	HDG	HDD
Freeways	88%	0%	2%	9%
Arterials	87%	0%	3%	11%
Collectors	86%	0%	3%	11%

Table 4: 2002 VMT Percentage for the Afternoon Period

	LDG	LDD	HDG	HDD
Freeways	93%	0%	1%	5%
Arterials	93%	0%	2%	6%
Collectors	91%	0%	2%	7%

Table 5: 2002 VMT Percentage for the Overnight Period

	LDG	LDD	HDG	HDD
Freeways	93%	0%	1%	7%
Arterials	92%	0%	1%	6%
Collectors	93%	0%	1%	5%

Table 6 shows the 2002 VMT, fuel consumption, and fuel economy for the four time periods.

Table 6: 2002 Fuel Consumption and Fuel Economy for the four time periods

	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
AM	21,489,238.20	984,162.20	184,893.49	1,169,055.68	18.38
MD	27,320,020.70	1,236,008.84	399,931.36	1,635,940.20	16.70
PM	27,624,353.50	1,276,422.36	220,789.10	1,497,211.45	18.45
OV	11,262,093.20	509,854.31	112,245.04	622,099.35	18.10

Figure 2: 2002 Daily Fuel Consumption by Time Period

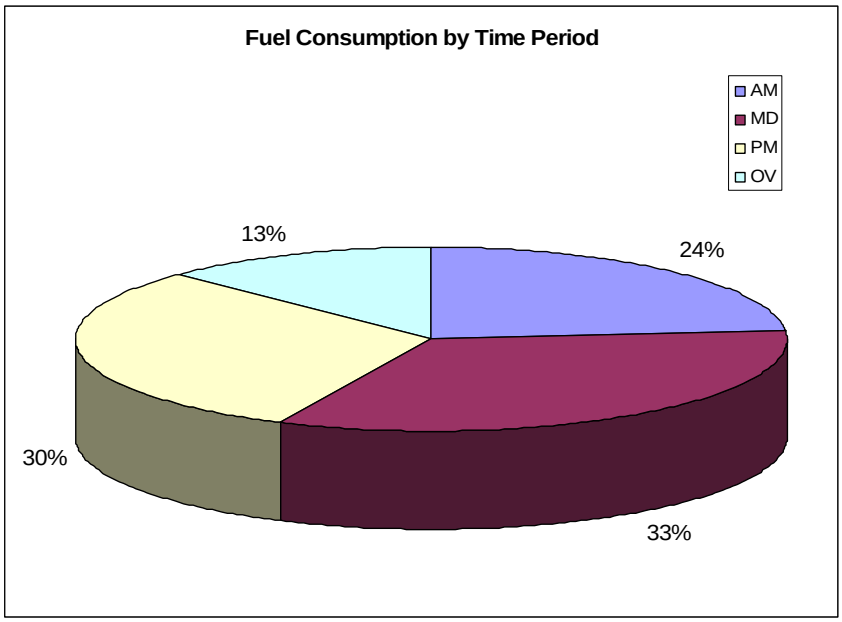


Figure 2 shows that for 2002 the midday period is the period with the largest fuel consumption although table 6 shows that the period with the largest VMT is the afternoon period. This is due to the fact that 2002 shows only a slight difference in VMT regarding the afternoon and midday periods and also to the fact that the midday period is the one with worse fuel economy because of the higher percentages of HDD vehicles on the road since the midday period is the one with the largest diesel consumption.

b) VMT & Fuel Consumption by Roadway Type

Table 7 shows the daily VMT, gasoline and diesel fuel consumption, and the fuel economy according to road type for 2002.

Table 7: 2002 Daily Fuel Consumption and Fuel Economy according to Road Type

ROADWAY TYPE	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
URBAN INTERSTATE (Fr)*	7,719,038.90	349,314.56	77,690.01	427,004.57	17.96303871
URBAN OTHER FREEWAY (Fr)	2,777,647.20	125,739.67	27,732.20	153,471.87	17.962981
TOLL ROADS (Fr)	4,325,418.20	196,000.30	41,623.29	237,623.60	17.96301658
RAMPS (FWY/TOLL/FRNT) (Fr)	535,489.20	24,332.93	5,687.42	30,020.36	18.0088374
URBAN PRIN. ART. (Ar)*	2,815,961.20	128,660.71	30,625.74	159,286.45	17.83772653
URBAN OTHER ART. (Ar)	4,632,839.40	211,707.68	50,059.99	261,767.67	17.83783925
URBAN COLLECTOR (Ar)	354,676.10	16,592.33	4,076.74	20,669.07	17.5743442
LOCAL (CENT. CONN.) (Co)*	6,975,113.70	329,406.98	79,945.79	409,352.77	17.44176307
RURAL INTERSTATE (Fr)	17,247,945.90	780,810.25	171,264.80	952,075.05	17.96302367
RURAL OTHER FREEWAY (Fr)	4,336,952.20	196,402.75	42,710.85	239,113.60	17.96306408
RURAL PRIN. ART. (Ar)	9,582,001.30	437,858.64	102,938.19	540,796.83	17.83782285
RURAL OTHER ART. (Ar)	24,196,120.50	1,105,879.77	258,548.79	1,364,428.56	17.83784299
RURAL MAJOR COL. (Co)	1,303,055.60	61,540.90	14,821.91	76,362.81	17.44173532
RURAL COLLECTOR (Co)	636,900.00	30,080.25	7,208.35	37,288.60	17.44167915
LOCAL (INTRAZONAL) (Co)	256,546.00	12,119.97	2,924.91	15,044.88	17.44166962
Total	87,695,705	4,006,448	917,859	4,924,307	17.80874163

*Where Fr, Ar and Co means freeway, arterial, and collector respectively.

Table 8: 2002 Daily Fuel Consumption and Fuel Economy for each of the aggregated Road way types

	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
Freeway	36,942,491.60	1,672,600.47	366,708.57	2,039,309.04	17.96
Arterial	41,581,598.50	1,900,699.13	446,249.45	2,346,948.58	17.84
Collector	9,171,615.30	433,148.10	104,900.95	538,049.05	17.44

Table 8 shows that for 2002 gasoline consumption is more than 4x diesel consumption for freeways, arterials and collectors. This agrees with the fact that from 2002 to 2007 has been an increase in HDD on collectors (see Tables 2-5).

Figure 3: 2002 Daily Fuel Consumption by Roadway Type

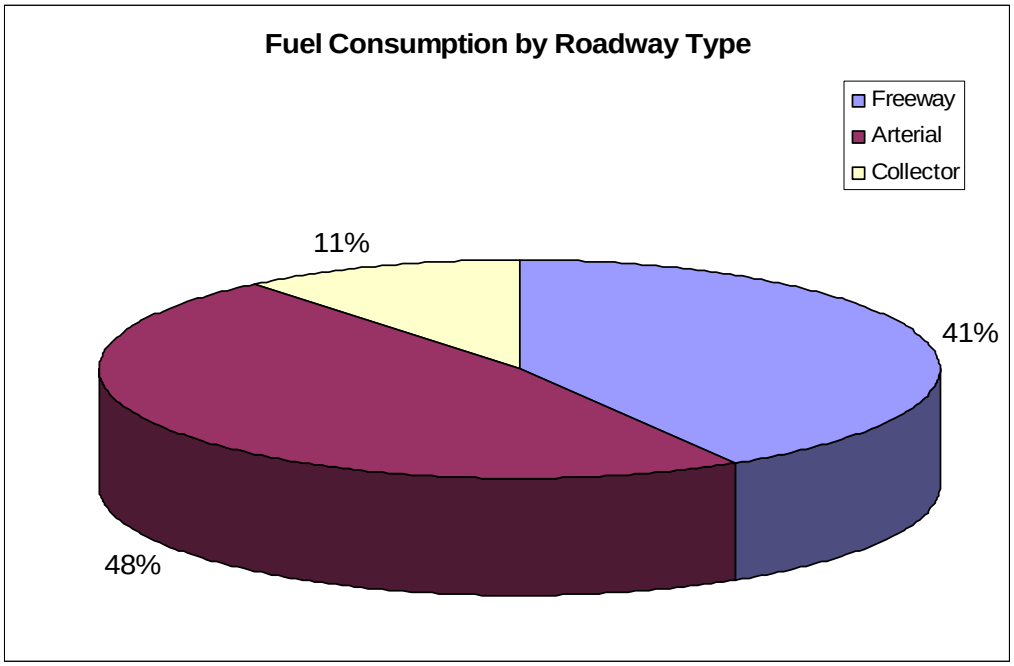


Figure 3 shows that the percentage of daily fuel consumption for the aggregated roadway types increased in freeways by 3% while it decreased in arterials by 3% from 2002 to 2007. This is mainly because the VMT has increased on freeways by 18% from 2002 to 2007, while the VMT on arterials has increased only by 4%.

c) VMT & Fuel Consumption by Vehicle Type

Table 9 shows the daily vehicle miles travel, fuel consumption, and daily fuel economy for each of the 28 vehicles classes for 2002. Table 10 shows this information in an aggregated format, where the vehicle types have been aggregated into light duty gas (LDG), heavy duty gas (HDG), light duty diesel (LDD), and heavy duty diesel (HDD) vehicles.

Table 9: 2002 Daily Fuel consumption for each of the 28 EPA's vehicle classifications

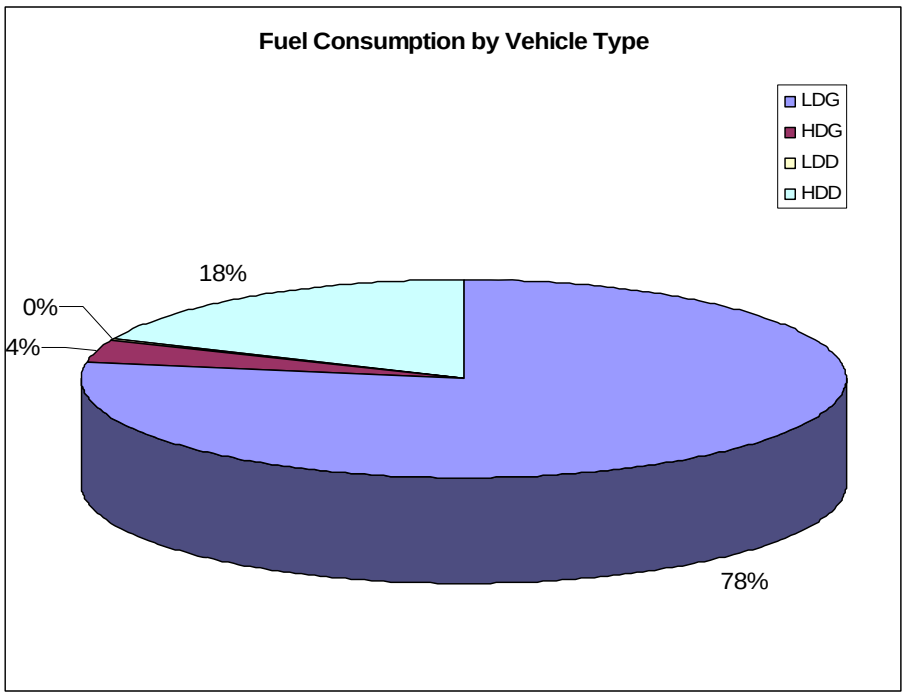
Vehicle Class	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
LDGV	52690614	2272124.626	0	2272124.626	23.19001933
LDGT1	4969492.1	271812.867	0	271812.867	18.28276989
LDGT2	16543970.8	904894.2753	0	904894.2753	18.28276656
LDGT3	3655139.4	259898.4184	0	259898.4184	14.06372314
LDGT4	1680898.6	119520.2585	0	119520.2585	14.06371289
HDGV2b	776490.6	80973.96961	0	80973.96961	9.589385376
HDGV3	290249	32657.36264	0	32657.36264	8.887704839
HDGV4	140637.3	15980.44847	0	15980.44847	8.800585305
HDGV5	50869.2	6654.321904	0	6654.321904	7.644535497
HDGV6	134190.2	17529.94336	0	17529.94336	7.654913497
HDGV7	47188	6682.430205	0	6682.430205	7.06150286
HDGV8a	47188	7063.759208	0	7063.759208	6.680295663
HDGV8b	5898.8	932.7035698	0	932.7035698	6.324410232
LDDV	86945.3	0	2778.569223	2778.569223	31.29139245
LDDT12	14331.2	0	664.8133887	664.8133887	21.55672591
HDDV2b	824188.5	0	67365.44216	67365.44216	12.23458904
HDDV3	397272	0	36092.2351	36092.2351	11.00713211
HDDV4	240141.4	0	24691.4789	24691.4789	9.725679087
HDDV5	157130.9	0	16745.76255	16745.76255	9.383323065
HDDV6	498071.9	0	59917.90023	59917.90023	8.312572672
HDDV7	302400.3	0	41545.16529	41545.16529	7.278832517
HDDV8a	545506	0	87534.5747	87534.5747	6.23189182
HDDV8b	3114632.7	0	527027.1587	527027.1587	5.909814416
MC	87620.9	1800.143857	0	1800.143857	48.67438768
HDGB	49252.5	7922.171955	0	7922.171955	6.217045058
HDDBT	94654.7	0	22848.28471	22848.28471	4.142748622
HDDBS	147761.6	0	24437.4806	24437.4806	6.046515286
LDDT34	102972.5	0	6210.115016	6210.115016	16.58141592
	87,695,708	4,006,448	917,859	4,924,307	17.80874224

Table 10: 2002 Daily Fuel Consumption by Aggregated Vehicle Classes

Vehicle class	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
LDG	79,627,736	3,830,051	0	3,830,051	21
HDG	1,541,964	176,397	0	176,397	9
LDD	204,249	0	9,653	9,653	23
HDD	6,321,760	0	908,205	908,205	8

From Table 10 and Figure 5 we can observe that the LDG and HDD increased by 1%, while the HDG decreased by 2% from 2002 to 2007.

Figure 5: 2002 Daily Fuel Consumption by Vehicle Type



Conclusions - 2002

- The overall fuel economy improved from 2002 to 2007 by 1.1% due to fleet turn over and an increased in number of LDG vehicles of 1%.
- The VMT increased by 10% between 2002 and 2007, which shows an increment of 2% per year.
- The total daily fuel consumption increased by 9% from 2002 to 2007 due to the increased in VMT since the increase in fuel economy is almost negligible.
- The plots for hourly VMT and fuel economy follow the same pattern as for 2007.
- The percentage of fuel consumption by vehicle type has increased for LDG and HDD by 1% and decreased for HDG by 2% from 2002 to 2007.

Results and Discussion – Future Year 2009

For this study it was used the 2006 Harris county registration distribution provided by TxDOT, the2009 VMT mix data provided by TTI**,** 2009 diesel fractions provided by TTI**,** MOBILE6.2 default miles per gallon data from EPA, and the 2009 vehicle miles traveled per hour per roadway type per vehicle type (output from IMPSUM62 program) provided by H-GAC.

a) VMT & Fuel Consumption by Time Period

Table 1: 2009 Hourly and Daily Total VMT, Fuel Consumption and Fuel Economy

Hour	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
12:00 AM	700,571.30	31,402.50	7,185.70	38,588.20	18.1550652
1:00 AM	464,371.10	20,814.90	4,763.03	25,577.93	18.15514466
2:00 AM	426,703.10	19,126.60	4,376.54	23,503.15	18.15514681
3:00 AM	405,501.20	18,176.23	4,159.21	22,335.44	18.155057
4:00 AM	687,743.80	30,827.50	7,054.30	37,881.80	18.15499233
5:00 AM	2,158,076.20	96,733.72	22,135.23	118,868.95	18.15508824
6:00 AM	7,600,723.10	345,413.16	67,008.00	412,421.16	18.42951771
7:00 AM	8,943,523.00	406,436.32	78,846.20	485,282.52	18.42951814
8:00 AM	7,384,336.50	335,579.47	65,100.26	400,679.72	18.42952382
9:00 AM	4,697,752.60	208,240.47	67,568.15	275,808.62	17.03265325
10:00 AM	4,563,338.30	202,282.19	65,634.89	267,917.08	17.03265159
11:00 AM	4,791,915.90	212,414.44	68,922.60	281,337.05	17.03265166
12:00 PM	4,967,437.80	220,195.01	71,447.04	291,642.05	17.03265313
1:00 PM	5,101,408.40	226,133.56	73,373.87	299,507.43	17.03266051
2:00 PM	5,452,216.30	241,684.04	78,419.65	320,103.69	17.03265673
3:00 PM	8,306,698.40	379,458.63	66,564.89	446,023.53	18.62390195
4:00 PM	9,216,402.40	421,014.92	73,854.74	494,869.66	18.6238986
5:00 PM	9,842,268.90	449,605.06	78,870.17	528,475.22	18.62389844
6:00 PM	7,932,716.20	362,374.66	63,568.00	425,942.66	18.62390627
7:00 PM	3,534,212.90	158,417.81	36,250.32	194,668.13	18.15506646
8:00 PM	2,774,935.40	124,383.91	28,462.45	152,846.36	18.15506361
9:00 PM	2,377,492.60	106,568.94	24,385.96	130,954.89	18.15504984
10:00 PM	1,841,654.80	82,550.47	18,889.80	101,440.27	18.15506685
11:00 PM	1,244,917.70	55,802.32	12,769.05	68,571.37	18.15506594
Total	105,416,918	4,755,637	1,089,610	5,845,247	18.03

From Table 1 we can observe that fuel economy has improved by 0.17% from 2007 to 2009 due to fleet turn over since the VMT mix patterns are about the same between 2007 and 2009 (see Tables 2-5).

Figure 1: 2009 Hourly VMT and Fuel Economy

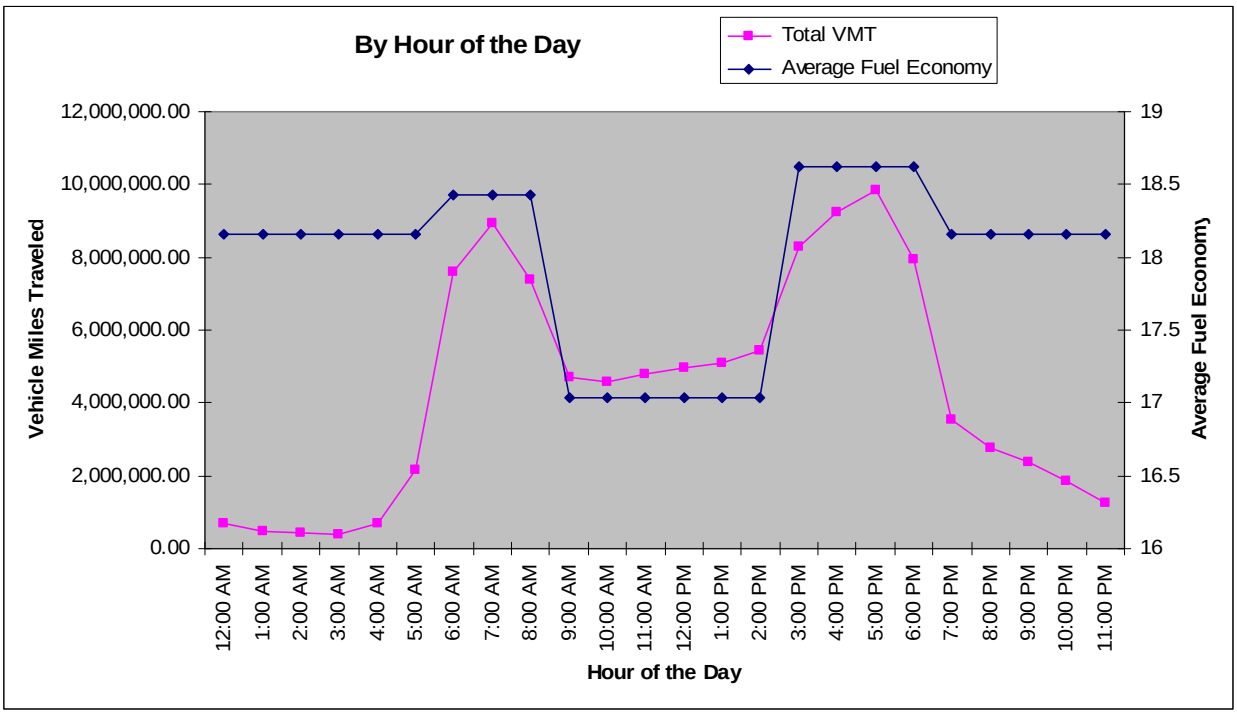


Figure 1 shows the same trend for 2009 as for 2007. Comparing VMT mix (tables 2-5) for 2009 with the ones for 2007, we observed that the VMT has the same percentages of vehicles categories on the same facilities types since they are only two years apart, and as a consequence the same analysis applies.

Table 2: 2009 VMT Percentages for the morning period

	LDG	LDD	HDG	HDD
Freeways	94%	0%	1%	5%
arterials	92%	0%	1%	6%
collectors	86%	0%	2%	12%

Table 3: 2009 VMT Percentages for the midday period

	LDG	LDD	HDG	HDD
Freeways	89%	0%	1%	9%
arterials	87%	0%	2%	11%
collectors	83%	0%	3%	15%

Table 4: 2009 VMT Percentages for the afternoon period

	LDG	LDD	HDG	HDD
Freeways	94%	0%	1%	5%
arterials	93%	0%	1%	6%
collectors	90%	0%	2%	9%

Table 5: 2009 VMT Percentages for the overnight period

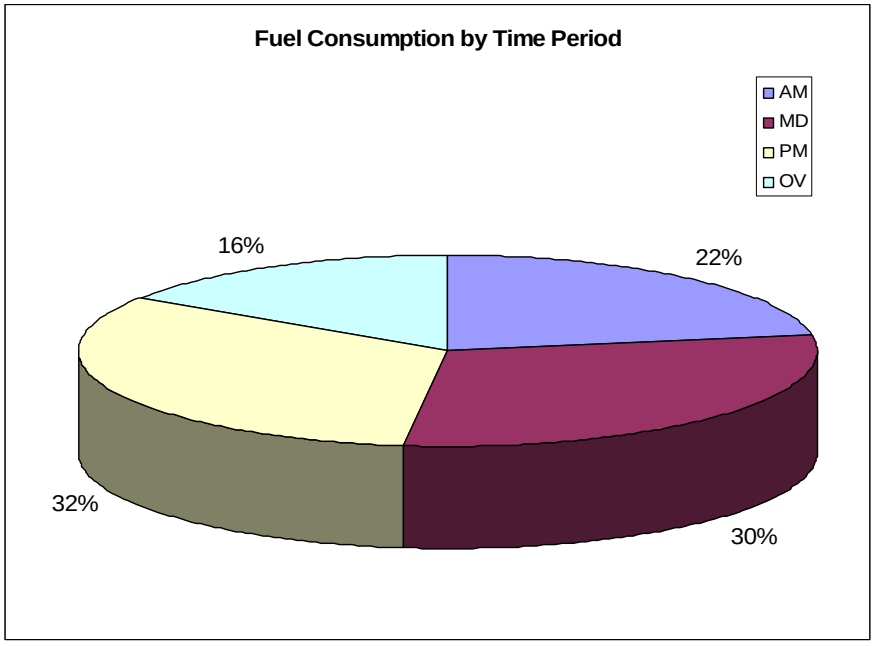
	LDG	LDD	HDG	HDD
Freeways	92%	0%	1%	7%
arterials	93%	0%	1%	6%
collectors	90%	0%	1%	9%

Table 6: 2009 Fuel Consumption and Fuel Economy for the four time periods

	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
AM	23,928,582.60	1,087,428.95	210,954.45	1,298,383.40	18.43
MD	29,574,069.30	1,310,949.72	425,366.19	1,736,315.92	17.03
PM	35,298,085.90	1,612,453.27	282,857.81	1,895,311.07	18.62
OV	16,616,180.10	744,804.91	170,431.58	915,236.49	18.16

Figure 2 shows the percentage of fuel consumption by time period for the year 2009 which shows the same distribution as 2007.

Figure 2: 2009 Daily Fuel Consumption by Time Period



b) VMT & Fuel Consumption by Roadway Type for future year 2009

Table 7: 2009 Daily Fuel Consumption and Fuel Economy according to Road Type from

ROADWAY TYPE	VMT	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
URBAN INTERSTATE (Fr)*	10,977,038.20	493,036.65	103,677.04	596,713.68	18.39582112
URBAN OTHER FREEWAY (Fr)	4,749,862.40	213,566.40	44,028.31	257,594.71	18.43928567
TOLL ROADS (Fr)	7,106,732.00	319,640.56	65,433.73	385,074.29	18.45548306
RAMPS (FWY/TOLL/FRNT (Fr)	636,178.70	28,651.83	6,499.22	35,151.05	18.09842728
URBAN PRIN. ART. (Ar)*	3,291,553.90	148,880.41	33,890.69	182,771.10	18.00916001
URBAN OTHER ART. (Ar)	7,324,633.10	331,349.81	75,058.04	406,407.85	18.02286325
URBAN COLLECTOR (Ar)	476,817.80	21,394.51	7,043.95	28,438.46	16.76665513
LOCAL (CENT. CONN.) (Co)*	8,166,965.80	370,058.59	121,728.05	491,786.65	16.60672543
RURAL INTERSTATE (Fr)	19,824,388.20	890,921.89	184,996.42	1,075,918.31	18.42555146
RURAL OTHER FREEWAY (Fr)	3,853,112.10	173,219.74	35,793.32	209,013.07	18.43479034
RURAL PRIN. ART. (Ar)	10,457,852.70	472,979.19	107,465.12	580,444.31	18.01697868
RURAL OTHER ART. (Ar)	25,902,235.10	1,171,834.75	264,747.64	1,436,582.39	18.03045568
RURAL MAJOR COL. (Co)	1,525,004.40	69,122.32	22,615.05	91,737.37	16.62359014
RURAL COLLECTOR (Co)	842,609.10	38,204.03	12,437.26	50,641.28	16.63877878
LOCAL (INTRAZONAL) (Co)	281,934.70	12,776.18	4,196.20	16,972.38	16.61138274
Total	105,416,918	4,755,637	1,089,610	5,845,247	18.03463914

*Where Fr, Ar and Co means freeway, arterial, and collector respectively.

Table 8 shows the daily fuel consumption after the road types have been aggregated into freeway, arterial and collector. Like for 2007, gasoline consumption on freeways and arterials is more than 4x that of diesel consumption, and for collectors is about 3x, which is consistent with the fact that there is a higher proportion of HDD traffic on collectors than other road types.

Table 8: 2009 Daily Fuel Consumption and Fuel Economy for each of the aggregated roadway types- 2009

	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
Freeway	47,147,311.60	2,119,037.06	440,428.05	2,559,465.11	18.42
Arterial	47,453,092.60	2,146,438.66	488,205.43	2,634,644.10	18.01
Collector	10,816,514.00	490,161.12	160,976.56	651,137.68	16.61

Figure 3 shows the percentage of daily fuel consumption for the aggregated road types, which is the same as for 2007.

Figure 3: 2009 Daily Fuel Consumption by Roadway Type

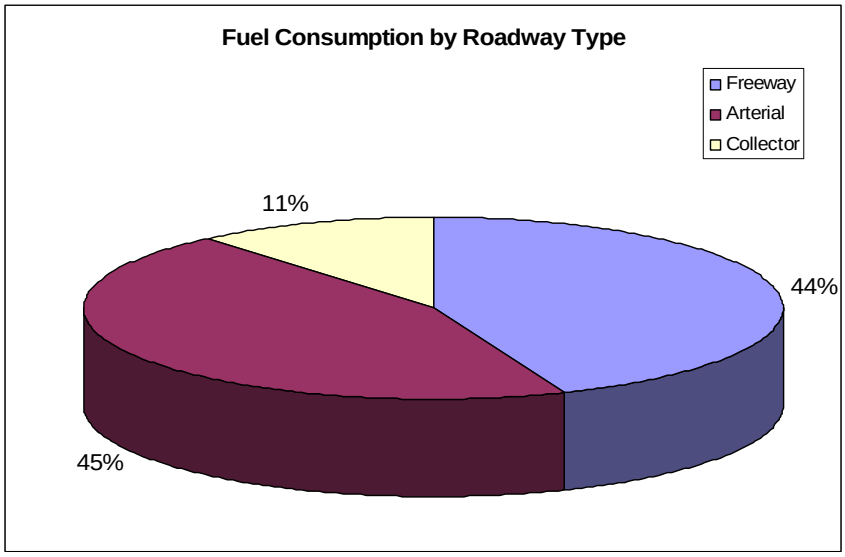
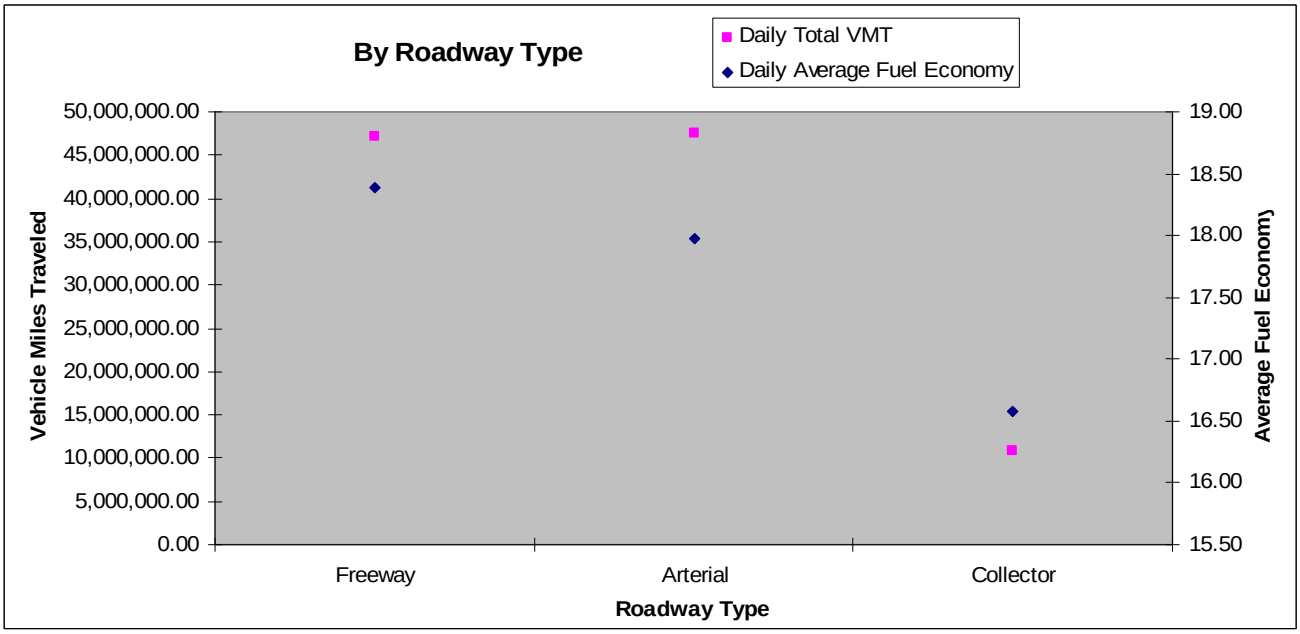


Figure 4 shows the daily VMT and average fuel economy by roadway type for 2009, which has the same pattern as for 2007 for the same reasons mentioned above.

Figure 4: 2009 Daily VMT and Fuel Economy by Roadway Type



c) VMT & Fuel Consumption by Vehicle Type

Table 9 shows the daily vehicle miles travel, fuel consumption, and daily fuel economy for each of the 28 vehicles classes for 2009. Table 10 shows this information in an aggregated format, where the vehicle types have been aggregated into light duty gas (LDG), heavy duty gas (HDG), light duty diesel (LDD), and heavy duty diesel (HDD) vehicles.

Table 9: 2009 Daily Fuel consumption for each of the 28 EPA's vehicle classifications

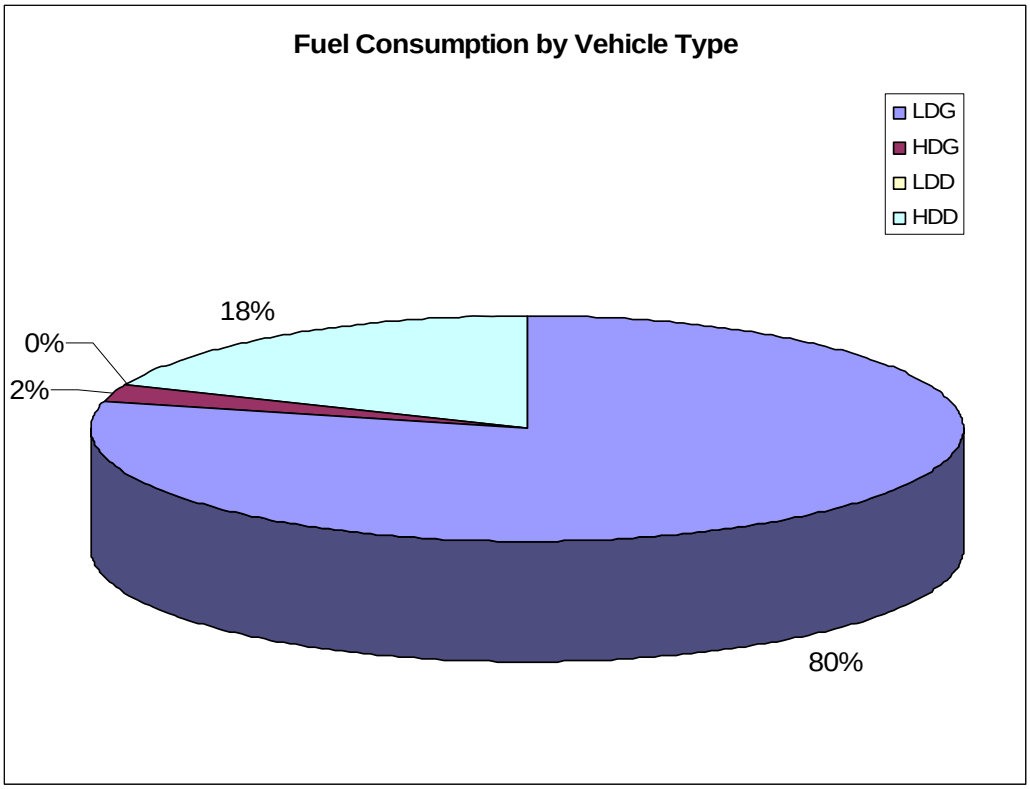
Vehicle Class	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
LDGV	63302439.3	2685278.829	0	2685278.829	23.57387941
LDGT1	5606706.7	307443.2839	0	307443.2839	18.23655612
LDGT2	18664801.6	1023482.876	0	1023482.876	18.23655484
LDGT3	5704894.4	407200.9884	0	407200.9884	14.010021
LDGT4	2623478.6	187257.2607	0	187257.2607	14.01002338
HDGV2b	715529.9	72704.57834	0	72704.57834	9.841607177
HDGV3	250816.7	27494.51615	0	27494.51615	9.1224264
HDGV4	99309.2	10946.14546	0	10946.14546	9.072526977
HDGV5	35647.4	4572.735465	0	4572.735465	7.795640109
HDGV6	96763.9	12252.21056	0	12252.21056	7.897668714
HDGV7	31829.6	4396.042716	0	4396.042716	7.240511991
HDGV8a	36922.8	5377.154781	0	5377.154781	6.866605389
HDGV8b	6364.6	971.4608204	0	971.4608204	6.551576622
LDDV	58014.5	0	1830.686976	1830.686976	31.69001623
LDDT12	894.6	0	41.26882269	41.26882269	21.67738117
HDDV2b	1527377.3	0	121405.8185	121405.8185	12.58075864
HDDV3	436935.9	0	38602.81722	38602.81722	11.3187568
HDDV4	262162.8	0	26420.18106	26420.18106	9.922823747
HDDV5	186171.6	0	19386.25304	19386.25304	9.603279169
HDDV6	558519	0	65902.4809	65902.4809	8.474931328
HDDV7	273560.2	0	37233.70716	37233.70716	7.347111553
HDDV8a	554717.2	0	86684.01444	86684.01444	6.39930215
HDDV8b	3780828.4	0	618529.7508	618529.7508	6.11260557
MC	105416.8	2153.357823	0	2153.357823	48.95461352
HDGB	25856.4	4105.405522	0	4105.405522	6.298135437
HDDBT	121413.7	0	28611.44261	28611.44261	4.243536464
HDDBS	228077	0	37669.75004	37669.75004	6.054645963
LDDT34	121466	0	7291.864427	7291.864427	16.6577425
Total	105,416,916	4,755,637	1,089,610	5,845,247	18.03

Table 10: 2009 Daily Fuel Consumption by Aggregated Vehicle Classes

Vehicle Class	VMT (miles)	Gas (gallons)	Diesel (gallons)	Total Fuel (gallons)	Fuel Economy (miles/gallon)
LDG	96,007,737	4,612,817	0	4,612,817	21
HDG	1,299,041	142,820	0	142,820	9
LDD	180,375	0	9,164	9,164	20
HDD	7,929,763	0	1,080,446	1,080,446	7

Figure 5 shows the percentage of daily fuel consumption according to the aggregated vehicle types for 2009, with the only difference with 2007 results are the 1% increase in LDG traffic and a 1% decrease in HDD traffic on 2009.

Figure 5: 2009 Daily Fuel Consumption by Vehicle Type



Conclusions - 2009

- The overall fuel economy has improved by 0.17% between 2007 and 2009 due to the fleet turn over and the increased by 1 % of LDG and the decreased by 1% of HDD vehicles.
- The VMT has increased by 9.1% between 2007 and 2009, which shows an increment of 4.5% per year due mainly to the opening of a major facility like Interstate-10.
- The total daily fuel consumption increased by 8.9% due to the increased in VMT since the increase in fuel economy is almost negligible.
- The plots for hourly VMT and fuel economy follow the same pattern as for 2007.
- The plots for fuel consumption by roadway type follow the same pattern as for 2007.
- The percentage of fuel consumption by vehicle type has increased for LDG by 1% and decreased for HDD by 1% from 2007 to 2009.

Further Conclusions and Recommendations

The study shows that the effect of fleet turn over is almost negligible due to the fact that the CAFÉ (Corporate Average Fuel Economy) standards have not changed for about 20 years. Between the years 2002 and 2007 the VMT and fuel consumption increased at an average of 2% per year, while between 2007 and 2009 the increase is about 4.5% per year, which gives a total average increase in VMT and fuel consumption of about 3% per year.
Due to these facts, and in order to decrease the fuel consumption, we recommend accelerating the implementation of new CAFÉ standards by 2010 instead of 2020 and making them at least 40 mpg based on different sources of information like[1]:

- The Union of Concerned Scientists, in Washington, DC, projects that the savings that will bring the new CAFÉ standard will be largely negated in 2020 by increased driving.

- Reports by the U.S. National Academy of Sciences[2], think tanks, and activists show that a combination of existing efficiency options, such as continuously variable transmissions and better tires, can cheaply and easily deliver a 35-miles-per-gallon fleet. (See "Why Not a 40-MPG SUV?")[3]

- Europe currently requires 40 miles per gallon average fuel economy and will soon push up to 49 miles per gallon, while Japan is expected to reach 47 miles per gallon in its 2015 standard.

- California officials estimated that the state standard would yield 35 miles per gallon from new cars by about 2016--four years ahead of CAFE.[4]

Other recommendations are an aggressive implementation of transit, hybrid vehicles, commute solution programs, and moving more freight by rail to replace trucks when possible throughout our region.

References

1. http://www.technologyreview.com/Energy/20067
2. http://www.nap.edu/catalog.php?record_id=10172
3. http://www.technologyreview.com/Energy/12989/
4. http://www.arb.ca.gov/cc/ccms/ab1493_v_cafe_study.pdf

Appendix A

Glossary

Roadway Functional Classification Definition

Urban Interstate: The urban section of a freeway that crosses state lines.

Urban Other Freeway: The urban section of a freeway.

Toll Roads: A high-speed road for which a driver pays a fee for use.

Ramps: A road junction that typically utilizes grade separation, and one or more roads, to permit traffic on at least one road to pass through the junction without crossing any other traffic stream. It differs from an intersection, at which roads cross at grade. Interchanges are almost always used when at least one of the roads is a freeway, though they may occasionally be used at junctions between two surface streets.

Urban Principal Arterial: The urban principal arterial system carries most of the trips entering and leaving the urban area, as well as most of the through movements bypassing the central city. In addition, this class of facility serves significant intra-area travel, such as between central business districts and outlying residential areas, between major inner-city communities, and between major suburban centers.

Urban Other Arterial: The minor arterial street system interconnects with and augments the urban principal arterial system. It accommodates trips of moderate length at a somewhat lower level of travel mobility than principal arterials do. This system distributes travel to geographic areas smaller than those identified with the higher system. The minor arterial street system includes all arterials not classified as principal.

Urban Collector: The collector street system provides both land access service and traffic circulation within residential neighborhoods and commercial and industrial areas. It differs from the arterial system in that it distributes trips from the arterials through the area to their ultimate destinations. Conversely, the collector street also collects traffic from local streets in neighborhoods and channels it into the arterial system.

Local-Centroid Connector: This classification represents pseudo links that load the traffic from a traffic analysis zone (TAZ) to the network.

Rural Interstate: The rural section of a freeway that crosses state lines.

Rural Other Freeway: The rural section of a freeway.

Rural Principal Arterial: 1. Corridor movement with trip length and density suitable for substantial statewide or interstate travel. 2. Movements between all, or virtually all, urban areas with populations over 50,000. 3. Integrated movements without stub connections except where unusual geographic or traffic flow conditions dictate otherwise (e.g., connections to coastal cities).

Rural Other Arterial: 1. Linkage of cities, larger towns, and other traffic generators that are capable of attracting travel over similarly long distances. 2. Integrated interstate and inter county service. 3. Internal spacing consistent with inter-county service. 4. Corridor movements consistent with items (1) through (3) with trip lengths and travel densities greater than those predominantly served by rural collector or local systems**.**

Rural Major Collector: 1. Serve county seats not on arterial routes, larger towns not directly served by the higher systems, and other traffic generators of equivalent intra-county importance, such as consolidated schools, county parks, etc. 2. Link these places with nearby larger towns or cities, or with routes of higher classification. 3. Serve the more important intra-county travel corridors.

Rural Collector: 1. Spaced at intervals consistent with population density to accumulate traffic from local roads and bring all developed areas within reasonable distance of collector roads. 2. Provide service to the remaining smaller communities.

Local-Intrazonal: This classification represents VMT for the trips made inside a traffic analysis zone (TAZ).

IMPSUM62

The IMPSUM62 program applies the emissions factors obtained from POLFAC62_3 (or from one of the RATEADJ programs, when used) and VMT mixes (fractions of fleet VMT attributable to each vehicle classification in the study) to the time-of-day fleet VMT and speed estimates to calculate emissions by the specified time periods. The five primary inputs to IMPSUM62 are:

- MOBILE6 emissions factors developed with POLFAC62_3 (or a RATEADJ, if used);
- Link-based hourly VMT and speeds developed using the TRANSVMTHSPDWKD or TRANSVMTHSPDWKE program. For each link, the following information is input to IMPSUM62: county number, roadway type number, VMT on link, operational link-speed estimate, and link distance;
- VMT mix by time period, county, and roadway type;
- X-Y coordinates (optional for gridded emissions); and
- Data records associating the MOBILE6 drive cycle (Freeway, Arterial, Local, and Ramp) emissions factors (or percentages thereof) to specific travel model functional classifications. These MOBILE6 drive cycle emissions factor percentages (valid from zero to 100) must sum to 100 percent for each travel model functional classification.

Using these input data, the VMT for each link is stratified by MOBILE6 drive cycle and the 28 vehicle types. The MOBILE6 emissions factors are matched to link VMT by drive cycle, speed, and vehicle type and are interpolated (for the speed that falls between the 14 MOBILE6 speeds, see the MOBILE6 interpolation methodology below) and multiplied by the link VMT to estimate the mobile source emissions for that link. Emissions factors for 65 mph are used for links with speeds greater than 65 mph, and emissions factors for 2.5 mph are used for links with speeds lower than 2.5 mph. The emissions for the county and emissions type are reported by both roadway type and vehicle type for each of the subject time periods. A data set is produced for

subsequent input to the SUMALL62 program. Also, link emissions may be written by county at the pollutant-specific emissions type sub-component level and 28 vehicle types level.

A tab delimited output is optionally produced. This output includes all 28 vehicle types (or eight vehicle types in the compressed format) across a single output line. Each field in the output is separated by a tab character.

TRANSVMTHSPDWKD

The TRANSVMTHSPDWKD program is a TRANSCAD-based utility that post-process TDMs to produce time-of-day specific, on-road vehicle, link VMT and speed estimates. The TRANSVMTHSPDWKD program processes a TDM traffic assignment consisting of four time-of-day assignments by scaling the link volumes by the appropriate HPMS, seasonal, or other VMT factors. Time-of-day factors are then applied to distribute the link VMT to each hour in the day. The Houston speed model is used to estimate the operational time-of-day speeds for each link (or by direction if the assignment is not directional). Since intrazonal links are not included in the TDMs, special intrazonal links are created and the VMT specifically designed for estimating VMT and speeds for weekdays (day types weekdays and Friday). The link VMT and speeds produced by these programs are subsequently input to the IMPSUM62 program for the application of MOBILE6 emission factors.

Registration Distribution

As with VMT fractions, MOBILE6 allows the entry of registration distributions for 16 vehicle classes, which combine the gasoline and diesel categories. MOBILE6 requires that all entries of registration distributions by vehicle class be in terms of the combined gasoline- and diesel-fuel categories.

Diesel Fractions

Diesel fractions allow to perform separate calculations for gas and diesel subcategories, which have distinctly different emission rates. Urban/transit buses are assumed to be all diesel-fueled, and motorcycles are assumed to be all gasoline-fueled, so these two categories do not require a diesel fraction. That leaves 14 composite vehicle categories for which users can specify a diesel fraction. The diesel fraction represents the percent of diesels in a composite vehicle category for any vehicle age.

VMT Mix

The VMT mix specifies the fraction of total highway VMT that is accumulated by each of the 16 composite vehicle types. Each VMT mix supplied as input must consist of a set of 16 fractional values, representing the fraction of total highway VMT accumulated by each of 16 combined vehicle types. All values must be between 0 and 1, and the 16 values must add up to 1.0.

MPG Data

The EPA mpg data from MOBILE6 was used in this study. This is fuel economy performance data by vehicle class and model year. The first number is a value from 1 thru 28 indicating the MOBILE6 vehicle class to which the record applies. Values 2 thru 100 specify the fuel economy performance of that vehicle class for model years 1952 thru 2050. (The 1952 value is used for model years prior to 1952.)

Road Link definition

The road network consist of several road segments which are called road links. These must be described with identification numbers, coordinates and name, also defined as the distance between two road nodes.

Appendix B

Input data

2006 Harris County Registration Distribution

```
REG DIST
* Harris County
* Vehicle Age Distributions Calculated from Mid-Year (July) 2006 Registrations data
* LDV, LDT, MC: based on Harris County data only
* HDV: based on 8-county nonattainment area aggregate data (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty,
    Montgomery, Waller)
* LDV
     1 0.07049 0.07996 0.06939 0.07028 0.07488 0.07479 0.07792 0.06771 0.06274 0.05804 0.04959 0.05006 0.03849
    0.03331 0.02679 0.02236 0.01777 0.01268 0.00904 0.00629 0.00487 0.00428 0.00317 0.00201 0.01309
* LDT1
     2 0.04938 0.06122 0.06287 0.07629 0.09132 0.08155 0.07379 0.06754 0.06573 0.06539 0.04459 0.04663 0.04182
    0.03061 0.02336 0.01911 0.01646 0.01538 0.01173 0.00783 0.00770 0.00684 0.00614 0.00356 0.02316
* LDT2
     3 0.04938 0.06122 0.06287 0.07629 0.09132 0.08155 0.07379 0.06754 0.06573 0.06539 0.04459 0.04663 0.04182
    0.03061 0.02336 0.01911 0.01646 0.01538 0.01173 0.00783 0.00770 0.00684 0.00614 0.00356 0.02316
* LDT3
     4 0.08747 0.11021 0.14584 0.12852 0.10288 0.09459 0.06374 0.07262 0.03007 0.03962 0.02588 0.02538 0.01522
    0.01264 0.00913 0.00646 0.00528 0.00459 0.00332 0.00167 0.00214 0.00239 0.00199 0.00124 0.00711
* LDT4
     5 0.08747 0.11021 0.14584 0.12852 0.10288 0.09459 0.06374 0.07262 0.03007 0.03962 0.02588 0.02538 0.01522
    0.01264 0.00913 0.00646 0.00528 0.00459 0.00332 0.00167 0.00214 0.00239 0.00199 0.00124 0.00711
* HDV2b
     6 0.13963 0.19440 0.11952 0.10407 0.08217 0.07976 0.06253 0.04866 0.02384 0.02949 0.01643 0.02006 0.01241
    0.01110 0.00890 0.00750 0.00625 0.00497 0.00396 0.00250 0.00405 0.00274 0.00262 0.00167 0.01077
* HDV3
     7 0.08955 0.07921 0.07339 0.06345 0.06455 0.08724 0.09587 0.09677 0.03072 0.05973 0.03042 0.05411 0.03745
    0.02650 0.01948 0.01646 0.01827 0.01295 0.00994 0.00432 0.00432 0.00532 0.00321 0.00151 0.01526
* HDV4
     8 0.08873 0.06957 0.07457 0.07165 0.07769 0.07998 0.11040 0.09623 0.04062 0.06457 0.05520 0.04582 0.02749
    0.01812 0.01375 0.01104 0.01146 0.00958 0.00750 0.00375 0.00312 0.00104 0.00354 0.00062 0.01396
* HDV5
     9 0.10982 0.11643 0.08336 0.07410 0.07608 0.08568 0.09196 0.10718 0.02812 0.02713 0.01720 0.02547 0.01489
    0.01125 0.01886 0.01356 0.01323 0.01059 0.01323 0.00860 0.00728 0.00430 0.00761 0.00364 0.03043
* HDV6
     10 0.07729 0.07740 0.06242 0.04318 0.04340 0.07562 0.09720 0.09642 0.07931 0.04172 0.03837 0.05280 0.02617
    0.02998 0.01868 0.02394 0.02450 0.01465 0.01342 0.00962 0.00951 0.00783 0.00805 0.00492 0.02360
* HDV7
     11 0.04309 0.05354 0.04779 0.05981 0.05171 0.06581 0.08984 0.09482 0.05746 0.06268 0.05876 0.06581 0.03656
    0.03238 0.02873 0.03291 0.02847 0.01541 0.01201 0.01149 0.00783 0.00731 0.00862 0.00418 0.02298
* HDV8a
     12 0.03568 0.03477 0.02640 0.03124 0.03058 0.03738 0.05359 0.05241 0.05045 0.03751 0.04797 0.07738 0.06431
    0.05921 0.04483 0.04836 0.04274 0.04692 0.04143 0.02758 0.01856 0.01934 0.01699 0.00431 0.05006
* HDV8b
     13 0.16445 0.10361 0.07700 0.05371 0.03470 0.07224 0.06844 0.09601 0.04515 0.03660 0.03184 0.05133 0.04183
    0.01901 0.01046 0.01949 0.01616 0.02614 0.00903 0.00760 0.00380 0.00190 0.00190 0.00000 0.00760
*   HDBS is MOBILE6 default
*   HDBT is MOBILE6 default
* MC
     16 0.12189 0.13076 0.09300 0.11321 0.09607 0.07752 0.06055 0.04912 0.03603 0.02614 0.02587 0.02146 0.01707
    0.01418 0.00868 0.00678 0.00651 0.00632 0.00649 0.00552 0.00945 0.00820 0.00625 0.00596 0.04697
```

2002 Harris County Registration Distribution

REG DIST
* Harris County
* LDV, LDT, and MC are county level; HDV (except bus) are HGB 8-county area level
* Calculated from Mid-Year (July) 2002 Registration data (from TTI)
* LDV
1 0.07627 0.09319 0.09265 0.08016 0.07495 0.07056 0.06405 0.06924 0.05598 0.05293 0.04619 0.04286 0.03761 0.03116 0.02468 0.01822 0.01479 0.01283 0.00962 0.00557 0.00414 0.00301 0.00224 0.00283 0.01426
* LDT1
2 0.08992 0.09874 0.08913 0.07863 0.07599 0.07446 0.05400 0.06141 0.06026 0.04917 0.04024 0.03446 0.02894 0.02839 0.02315 0.01653 0.01649 0.01535 0.01317 0.00749 0.00886 0.00667 0.00338 0.00457 0.02062
* LDT2
3 0.08992 0.09874 0.08913 0.07863 0.07599 0.07446 0.05400 0.06141 0.06026 0.04917 0.04024 0.03446 0.02894 0.02839 0.02315 0.01653 0.01649 0.01535 0.01317 0.00749 0.00886 0.00667 0.00338 0.00457 0.02062
* LDT3
4 0.14705 0.18228 0.12654 0.14564 0.05791 0.07428 0.04776 0.04732 0.02870 0.02556 0.01903 0.01517 0.01247 0.01181 0.00922 0.00512 0.00687 0.00692 0.00667 0.00370 0.00445 0.00225 0.00184 0.00314 0.00831
* LDT4
5 0.14705 0.18228 0.12654 0.14564 0.05791 0.07428 0.04776 0.04732 0.02870 0.02556 0.01903 0.01517 0.01247 0.01181 0.00922 0.00512 0.00687 0.00692 0.00667 0.00370 0.00445 0.00225 0.00184 0.00314 0.00831
* HDV2b
6 0.12549 0.14885 0.14233 0.12668 0.08635 0.05306 0.07035 0.03391 0.04193 0.02309 0.02385 0.01715 0.01441 0.01259 0.01113 0.01082 0.00656 0.00771 0.00700 0.00749 0.00359 0.00660 0.00448 0.00310 0.01148
* HDV3
7 0.04688 0.07526 0.10778 0.11846 0.12478 0.03849 0.07928 0.04102 0.07687 0.06182 0.04171 0.03194 0.02631 0.02792 0.01999 0.01666 0.00770 0.00804 0.00965 0.00609 0.00264 0.00437 0.00345 0.00218 0.02068
* HDV4
8 0.06016 0.09553 0.10019 0.14277 0.12434 0.04914 0.08685 0.06397 0.07626 0.03919 0.02881 0.02288 0.01758 0.01695 0.01440 0.00932 0.00551 0.00360 0.00424 0.00466 0.00212 0.00424 0.00339 0.00191 0.02203
* HDV5
9 0.06186 0.09005 0.10650 0.13665 0.15857 0.04542 0.04307 0.03054 0.04150 0.02819 0.02193 0.02467 0.02153 0.02075 0.01879 0.02193 0.01684 0.01410 0.01135 0.01175 0.00901 0.00979 0.01096 0.00783 0.03641
* HDV6
10 0.03500 0.05167 0.08642 0.10604 0.11463 0.07886 0.05334 0.04924 0.07334 0.03590 0.04334 0.02847 0.03398 0.03654 0.02500 0.02090 0.01949 0.01693 0.01641 0.01334 0.00769 0.01244 0.00962 0.00487 0.02654
*HDV7
11 0.04494 0.04805 0.06479 0.08941 0.09897 0.06933 0.06503 0.06240 0.09037 0.04279 0.03514 0.03705 0.05570 0.04375 0.02606 0.02247 0.01721 0.01387 0.01458 0.01458 0.00669 0.00693 0.00837 0.00478 0.01673
*HDV8a
12 0.02072 0.03495 0.03827 0.05153 0.04808 0.04490 0.03468 0.05001 0.07267 0.06314 0.05982 0.04615 0.05443 0.05665 0.06148 0.05057 0.03426 0.02404 0.03081 0.02445 0.00746 0.01534 0.01644 0.01603 0.04311
*HDV8b
13 0.05676 0.04757 0.08054 0.09135 0.13243 0.07351 0.06595 0.03676 0.08973 0.06595 0.05568 0.01892 0.02973 0.02649 0.05405 0.01622 0.01459 0.00865 0.00649 0.00919 0.00162 0.00378 0.00324 0.00162 0.00919
* HDBS is MOBILE6 default
* HDBT is MOBILE6 default
* MC
16 0.13399 0.14592 0.11404 0.09350 0.06670 0.05159 0.04948 0.04329 0.03351 0.03109 0.01874 0.01266 0.01314 0.01224 0.01245 0.01069 0.02026 0.01566 0.01279 0.01407 0.01781 0.01151 0.01117 0.00927 0.04440

2006 Houston-Eight-County Region Diesel sales Fraction Estimates

* Statewide Diesel Sales Fractions Estimates -
* HDV fractions are estimated from TxDOT registration data (Mid-year July 2006)
* LDV, LDT and Bus fractions are EPA defaults
* One record per vehicle type. The order of vehicle types is: LDV, LDT1, LDT2, LDT3, LDT4, HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8a, HDV8b, HDBS
DIESEL FRACTIONS :
0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00060
0.00010 0.00030 0.00060 0.00130 0.00040 0.00040 0.00010 0.00270 0.00320 0.00970 0.01620 0.02410
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00070 0.00330 0.00480 0.01200 0.02230
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00070 0.00330 0.00480 0.01200 0.02230
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01150
0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720 0.00820 0.01240 0.01350 0.01690 0.02090
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01150
0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720 0.00820 0.01240 0.01350 0.01690 0.02090
0.76017 0.76017 0.84307 0.84251 0.78277 0.75461 0.70514 0.57915 0.62202 0.52436 0.45371 0.43381 0.20803
0.39742 0.37869 0.36273 0.36193 0.29899 0.25935 0.20173 0.17593 0.18117 0.15677 0.18774 0.15730
0.76301 0.76301 0.71128 0.68870 0.64158 0.64241 0.62779 0.64127 0.61219 0.48276 0.56004 0.52845 0.33472
0.55155 0.55776 0.60948 0.48645 0.57089 0.48730 0.37008 0.25197 0.29870 0.22917 0.22500 0.18018
0.90055 0.90055 0.81739 0.77179 0.73560 0.69790 0.69545 0.72335 0.65187 0.69828 0.74316 0.64837 0.42986
0.64665 0.65988 0.60791 0.69097 0.57237 0.64754 0.23711 0.26897 0.08734 0.11165 0.26744 0.17308
0.91101 0.91101 0.84832 0.88419 0.86117 0.88347 0.85451 0.88665 0.86334 0.68644 0.72423 0.79282 0.50188
0.65098 0.70089 0.65700 0.74336 0.61589 0.59091 0.34944 0.33962 0.23346 0.24887 0.22857 0.25000
0.89299 0.89299 0.88010 0.89139 0.89759 0.90888 0.89029 0.86180 0.82947 0.80299 0.78766 0.80240 0.61830
0.79507 0.77504 0.62887 0.68100 0.73734 0.73977 0.61833 0.69269 0.56734 0.46809 0.49421 0.46831
0.92874 0.92874 0.96480 0.95556 0.98089 0.90539 0.89625 0.90644 0.89547 0.85472 0.77535 0.83566 0.57252
0.84799 0.85854 0.87861 0.88725 0.84466 0.87390 0.81703 0.85127 0.79863 0.78596 0.70455 0.72414
0.97154 0.97154 0.96951 0.94980 0.95519 0.95373 0.94351 0.93533 0.96098 0.95342 0.91217 0.93145 0.76593
0.95473 0.94826 0.95111 0.93274 0.93902 0.94132 0.95172 0.94682 0.91259 0.92426 0.93640 0.88000
0.99331 0.99331 0.99560 0.99012 0.99614 0.98276 0.98540 0.99020 0.98204 0.97851 0.94145 0.99440 0.74603
0.97576 0.97490 0.97333 0.96000 0.92045 0.95050 0.95238 0.94231 0.95833 0.97101 0.94118 0.88889
0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.88570

0.85250 0.87950 0.99000 0.91050 0.87600 0.77100 0.75020 0.73450 0.67330 0.51550 0.38450 0.32380

2002 Houston-Eight-County Region Diesel sales Fraction Estimates

* 2002 Statewide Diesel Sales Fractions Estimates
* HDV fractions are estimated from TxDOT registration data (Mid-year July 2002)
* LDV, LDT and Bus fractions are EPA defaults
* One record per vehicle type. The order of vehicle types is: LDV, LDT1, LDT2, LDT3, LDT4, HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8a, HDV8b, HDBS

DIESEL FRACTIONS :
0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00060 0.00010 0.00030 0.00060 0.00130 0.00040
0.00040 0.00010 0.00270 0.00320 0.00970 0.01620 0.02410 0.05100 0.07060 0.03900 0.02690 0.01140
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00070 0.00330 0.00480 0.01200 0.02230 0.06560 0.06160 0.04390 0.03160 0.02590
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00070 0.00330 0.00480 0.01200 0.02230 0.06560 0.06160 0.04390 0.03160 0.02590
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960
0.00830 0.00720 0.00820 0.01240 0.01350 0.01690 0.02090 0.02560 0.00130 0.00060 0.00110 0.00010
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960
0.00830 0.00720 0.00820 0.01240 0.01350 0.01690 0.02090 0.02560 0.00130 0.00060 0.00110 0.00010
0.81361 0.75050 0.61397 0.66232 0.57703 0.47784 0.45121 0.20063 0.39808 0.37552 0.32844 0.35352 0.27226
0.22309 0.17730 0.14483 0.20196 0.17056 0.19074 0.17148 0.14044 0.00323 0.00000 0.00382 0.00303
0.68374 0.64723 0.65615 0.64013 0.51450 0.57439 0.54389 0.32661 0.55020 0.58601 0.62333 0.51890 0.51653
0.46856 0.35294 0.25512 0.29752 0.17664 0.22368 0.21759 0.16066 0.03297 0.01508 0.00373 0.00406
0.75174 0.71334 0.72152 0.63857 0.67967 0.73075 0.66667 0.44671 0.70203 0.69632 0.65581 0.65789 0.57317
0.60350 0.35745 0.24855 0.13542 0.12313 0.18852 0.13253 0.17797 0.14583 0.05000 0.03185 0.01034
0.92205 0.86775 0.89367 0.88016 0.75422 0.72991 0.80476 0.45659 0.67857 0.72535 0.65432 0.70483 0.60383
0.59509 0.41699 0.33654 0.25337 0.30960 0.25418 0.28244 0.20767 0.23790 0.14394 0.12340 0.03350
0.92645 0.87176 0.86671 0.86169 0.81933 0.74312 0.78239 0.54923 0.77170 0.75818 0.57117 0.66954 0.72241
0.69427 0.56318 0.62198 0.54717 0.46968 0.43758 0.40440 0.37461 0.43137 0.18953 0.14992 0.04644
0.93134 0.87037 0.90479 0.88593 0.84672 0.75646 0.81899 0.48829 0.82916 0.84387 0.84789 0.85788 0.83389
0.82784 0.81143 0.81176 0.78571 0.74359 0.73051 0.70909 0.63052 0.70608 0.36715 0.27615 0.20888
0.95095 0.93265 0.93355 0.94685 0.94189 0.86917 0.90694 0.67588 0.96360 0.95187 0.94895 0.93046 0.94083
0.94469 0.95000 0.94092 0.91551 0.91340 0.92834 0.91875 0.91908 0.88970 0.56726 0.56641 0.55152
0.98020 0.98603 0.99167 0.98288 0.98189 0.95390 0.99119 0.78746 0.96058 0.98670 0.96262 1.00000 0.95333
0.97500 0.95238 0.92424 0.92958 0.98969 0.95455 0.97143 0.94286 0.96296 0.40000 0.44444 0.51064
0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.88570 0.85250 0.87950 0.99000 0.91050 0.87600
0.77100 0.75020 0.73450 0.67330 0.51550 0.38450 0.32380 0.32600 0.26390 0.05940 0.04600 0.02910

2009 Houston-Eight-County Region Diesel sales Fraction Estimates

* Statewide Diesel Sales Fractions Estimates - 2009
* HDV fractions are estimated from TxDOT registration data (Mid-year July 2005)
* LDV, LDT and Bus fractions are EPA defaults
* One record per vehicle type. The order of vehicle types is: LDV, LDT1, LDT2, LDT3, LDT4, HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8a, HDV8b, HDBS

DIESEL FRACTIONS :

0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090 0.00090
0.00090 0.00060 0.00010 0.00030 0.00060 0.00130 0.00040 0.00040 0.00010 0.00270 0.00320 0.00970
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00070 0.00330 0.00480
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00070 0.00330 0.00480
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720 0.00820 0.01240 0.01350
0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260 0.01260
0.01260 0.01150 0.01110 0.01450 0.01150 0.01290 0.00960 0.00830 0.00720 0.00820 0.01240 0.01350
0.80727 0.80727 0.80727 0.80727 0.80727 0.85880 0.79626 0.76336 0.71156 0.57882 0.62666 0.53215 0.45513
0.43053 0.20721 0.39488 0.37150 0.35696 0.36316 0.29108 0.24619 0.18987 0.16935 0.18496 0.15575
0.75422 0.75422 0.75422 0.75422 0.75422 0.69565 0.64314 0.63874 0.63332 0.63221 0.61230 0.48030 0.56752
0.53492 0.32654 0.54201 0.55668 0.61608 0.48880 0.56212 0.49160 0.36852 0.26829 0.32512 0.19953
0.82953 0.82953 0.82953 0.82953 0.82953 0.75912 0.72704 0.68240 0.69571 0.72079 0.65446 0.67783 0.73703
0.65948 0.43887 0.65817 0.67624 0.62701 0.69375 0.57605 0.61423 0.26263 0.24503 0.10700 0.10573
0.82614 0.82614 0.82614 0.82614 0.82614 0.88206 0.85909 0.88344 0.84910 0.88533 0.85240 0.70056 0.72396
0.80220 0.49180 0.63941 0.72500 0.63594 0.73795 0.59627 0.63309 0.33569 0.34450 0.22581 0.30159
0.88811 0.88811 0.88811 0.88811 0.88811 0.88834 0.89974 0.92151 0.87787 0.85887 0.82563 0.78874 0.77934
0.80210 0.60857 0.79070 0.77868 0.60498 0.68447 0.74280 0.73388 0.58797 0.67378 0.57627 0.46954
0.96056 0.96056 0.96056 0.96056 0.96056 0.95136 0.98026 0.89626 0.89382 0.90778 0.88756 0.84000 0.77970
0.83333 0.55516 0.83757 0.85385 0.88809 0.88287 0.85229 0.88219 0.80270 0.83740 0.76855 0.77287
0.96719 0.96719 0.96719 0.96719 0.96719 0.95265 0.95541 0.95288 0.93773 0.93368 0.95825 0.94940 0.90797
0.92862 0.75307 0.95733 0.95373 0.94996 0.93049 0.93216 0.94866 0.95047 0.93968 0.91036 0.91883
0.99150 0.99150 0.99150 0.99150 0.99150 0.98783 0.99435 0.98311 0.98820 0.98844 0.97735 0.98077 0.95736
0.99504 0.76660 0.97368 0.96629 0.97849 0.98291 0.93258 0.94958 0.96970 0.92453 0.93651 0.96250
0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850 0.95850
0.95850 0.88570 0.85250 0.87950 0.99000 0.91050 0.87600 0.77100 0.75020 0.73450 0.67330 0.51550

HGA 2007 Weekday VMT Mix by Time Period and Roadway Functional Classification Group

Obs	TP	FC	P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2b	P_HDGV_3	P_HDGV_4	P_HDGV_5
1	AM_Peak	Art	0.606392	0.054174	0.18034	0.055251	0.025409	0.006187	0.002169	0.000859	0.000308
2	AM_Peak	Col	0.511504	0.059313	0.197448	0.064304	0.029572	0.009773	0.003426	0.001356	0.000487
3	AM_Peak	Fway	0.635466	0.051722	0.172179	0.051473	0.023671	0.005097	0.001787	0.000707	0.000254
4	Mid_Day	Art	0.569791	0.051509	0.17147	0.052611	0.024195	0.010364	0.003633	0.001438	0.000516
5	Mid_Day	Col	0.489634	0.056579	0.188348	0.061355	0.028216	0.013981	0.004901	0.00194	0.000697
6	Mid_Day	Fway	0.606466	0.049329	0.164214	0.049118	0.022588	0.008263	0.002897	0.001147	0.000412
7	Ovr_Nite	Art	0.606257	0.054861	0.182629	0.055867	0.025692	0.004452	0.00156	0.000618	0.000222
8	Ovr_Nite	Col	0.531057	0.062401	0.20773	0.067494	0.031039	0.006817	0.002389	0.000946	0.00034
9	Ovr_Nite	Fway	0.62296	0.050531	0.168215	0.050226	0.023097	0.003996	0.001401	0.000555	0.000199
10	PM_Peak	Art	0.605747	0.054942	0.182899	0.056129	0.025812	0.00615	0.002156	0.000854	0.000306
11	PM_Peak	Col	0.529051	0.061736	0.205514	0.06687	0.030752	0.008595	0.003013	0.001193	0.000428
12	PM_Peak	Fway	0.637333	0.051892	0.172743	0.05173	0.023789	0.004734	0.001659	0.000657	0.000236

Obs	P_HDGV_6	P_HDGV_7	P_HDGV8a	P_HDGV8b	P_LDDV	P_LDDT12	P_HDDV2b	P_HDDV_3	P_HDDV_4	P_HDDV_5
1	0.000837	0.000275	0.000319	0.000055	0.000609	4.13E-05	0.013646	0.003904	0.002342	0.001663
2	0.001322	0.000435	0.000504	8.69E-05	0.000514	4.52E-05	0.023584	0.006747	0.004048	0.002875
3	0.000689	0.000227	0.000263	4.53E-05	0.000638	3.94E-05	0.009939	0.002843	0.001706	0.001212
4	0.001402	0.000461	0.000535	9.22E-05	0.000572	3.93E-05	0.022503	0.006437	0.003862	0.002743
5	0.001891	0.000622	0.000721	0.000124	0.000492	4.31E-05	0.033608	0.009614	0.005769	0.004097
6	0.001118	0.000368	0.000426	7.35E-05	0.000609	3.76E-05	0.016019	0.004583	0.00275	0.001953
7	0.000602	0.000198	0.00023	3.96E-05	0.000609	4.18E-05	0.009802	0.002804	0.001683	0.001195
8	0.000922	0.000303	0.000352	6.06E-05	0.000533	4.76E-05	0.016715	0.004782	0.002869	0.002037
9	0.00054	0.000178	0.000206	3.56E-05	0.000625	3.85E-05	0.007785	0.002227	0.001336	0.000949
10	0.000832	0.000274	0.000317	5.47E-05	0.000608	4.19E-05	0.013475	0.003855	0.002313	0.001643
11	0.001162	0.000382	0.000444	7.65E-05	0.000531	4.71E-05	0.020975	0.006	0.0036	0.002557
12	0.00064	0.000211	0.000244	4.21E-05	0.00064	3.96E-05	0.00921	0.002635	0.001581	0.001123

Obs	P_HDDV_6	P_HDDV_7	P_HDDV8a	P_HDDV8b	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34
1	0.00499	0.002444	0.004956	0.025753	0.001	0.000456	0.001585	0.002852	0.001185
2	0.008624	0.004224	0.008565	0.049452	0.001	0.000884	0.003075	0.005535	0.001298

3	0.003635	0.00178	0.00361	0.024758	0.001	0.000385	0.001337	0.002407	0.001132
4	0.008229	0.00403	0.008173	0.051377	0.001	0.000176	0.000613	0.001103	0.001127
5	0.01229	0.006019	0.012206	0.059742	0.001	0.000454	0.001579	0.002841	0.001238
6	0.005858	0.002869	0.005818	0.048634	0.001	0.000221	0.000769	0.001384	0.001079
7	0.003585	0.001756	0.00356	0.037665	0.001	0.000174	0.000607	0.001092	0.0012
8	0.006112	0.002994	0.006071	0.040234	0.001	0.000316	0.001099	0.001977	0.001365
9	0.002847	0.001394	0.002827	0.052841	0.001	0.000269	0.000935	0.001683	0.001105
10	0.004928	0.002413	0.004894	0.023508	0.001	0.00034	0.001182	0.002126	0.001202
11	0.00767	0.003757	0.007618	0.0279	0.001	0.000725	0.00252	0.004535	0.001351
12	0.003368	0.00165	0.003345	0.024838	0.001	0.000329	0.001143	0.002056	0.001135

HGA 2002 Weekday VMT Mix by Time Period and Roadway Functional Classification Group input to IMPSUM62

Obs TP	TP		P_LDGV	P_LDGT1	P_LDGT2	P_LDGT3	P_LDGT4	P_HDGV2b	P_HDGV_3	P_HDGV_4	P_HDGV_5
		FC									
1	AM_Peak	Art	0.6087356	0.0577513	0.1922602	0.0425562	0.0195704	0.0074199	0.0027735	0.0013439	0.0004861
2	AM_Peak	Col	0.5238475	0.0668714	0.2226219	0.0545082	0.0250668	0.0105828	0.0039558	0.0019167	0.0006933
3	AM_Peak	Fway	0.6404145	0.0540861	0.1800585	0.0379808	0.0174663	0.0065673	0.0024548	0.0011895	0.0004302
4	Mid_Day	Art	0.5719093	0.0544267	0.1811924	0.0400736	0.0184288	0.0128209	0.0047924	0.0023221	0.0008399
5	Mid_Day	Col	0.5026044	0.0638461	0.2125504	0.0520627	0.0239423	0.0162212	0.0060634	0.0029379	0.0010627
6	Mid_Day	Fway	0.6074268	0.0513717	0.1710219	0.0361381	0.0166189	0.0110513	0.0041309	0.0020016	0.000724
7	Ovr_Nite	Art	0.6082981	0.0582618	0.1939598	0.0429035	0.0197302	0.005308	0.0019841	0.0009614	0.0003477
8	Ovr_Nite	Col	0.5438097	0.0697157	0.2320909	0.0568072	0.0261241	0.0075691	0.0028293	0.0013709	0.0004959
9	Ovr_Nite	Fway	0.6095817	0.0582868	0.194043	0.0429833	0.0197668	0.0076043	0.0028425	0.0013773	0.0004982
10	PM_Peak	Art	0.6095817	0.0582868	0.194043	0.0429833	0.0197668	0.0076043	0.0028425	0.0013773	0.0004982
11	PM_Peak	Col	0.5336237	0.0682929	0.2273542	0.0556555	0.0255945	0.0099779	0.0037297	0.0018072	0.0006537
12	PM_Peak	Fway	0.6404359	0.0542842	0.1807178	0.0382573	0.0175935	0.0064816	0.0024228	0.0011739	0.0004246
Obs	P_HDGV_6	P_HDGV_7	P_HDGV8a	P_HDGV8b	P_LDDV	P_LDDT12	P_HDDV2b	P_HDDV_3	P_HDDV_4	P_HDDV_5	
1	0.001301	0.0004575	0.0004575	0.0000572	0.0010029	0.0001673	0.0082776	0.0039899	0.0024118	0.0015781	
2	0.0018556	0.0006525	0.0006525	0.0000816	0.0008633	0.0001938	0.0119617	0.0057657	0.0034852	0.0022805	
3	0.0011515	0.0004049	0.0004049	0.0000506	0.001055	0.0001567	0.0066315	0.0031965	0.0019322	0.0012643	
4	0.002248	0.0007905	0.0007905	0.0000988	0.0009423	0.0001577	0.0141395	0.0068155	0.0041198	0.0026957	
5	0.0028442	0.0010002	0.0010002	0.000125	0.0008283	0.000185	0.0185348	0.008934	0.0054004	0.0035336	

6	0.0019377	0.0006814	0.0006814	0.0000852	0.0010007	0.0001489	0.0110953	0.0053481	0.0032328	0.0021153	
7	0.0009307	0.0003273	0.0003273	0.0000409	0.0010022	0.0001688	0.0059433	0.0028648	0.0017317	0.0011331	
8	0.0013271	0.0004667	0.0004667	0.0000583	0.0008961	0.000202	0.0086441	0.0041666	0.0025186	0.001648	
9	0.0008947	0.0003146	0.0003146	0.0000393	0.0010348	0.0001536	0.0051723	0.0024931	0.001507	0.0009861	
10	0.0013333	0.0004689	0.0004689	0.0000586	0.0010043	0.0001689	0.0084594	0.0040776	0.0024648	0.0016128	
11	0.0017495	0.0006152	0.0006152	0.0000769	0.0008793	0.0001979	0.011535	0.00556	0.0033609	0.0021991	
12	0.0011365	0.0003996	0.0003996	0.00005	0.001055	0.0001573	0.0065309	0.003148	0.0019029	0.0012451	
Obs	P_HDDV_6	P_HDDV_7	P_HDDV8a	P_HDDV8b	P_MC	P_HDGB	P_HDDBT	P_HDDBS	P_LDDT34		
1	0.0050023	0.0030371	0.0054787	0.0269317	0.001	0.0008021	0.0015415	0.0024064	0.0012024		
2	0.0072286	0.0043888	0.0079171	0.0322248	0.001	0.0013495	0.0025936	0.0040487	0.0013922		
3	0.0040075	0.0024332	0.0043892	0.0260497	0.001	0.000692	0.0013299	0.0020761	0.0011261		
4	0.0085448	0.0051879	0.0093585	0.0530603	0.001	0.0003565	0.0006851	0.0010695	0.0011331		
5	0.0112009	0.0068005	0.0122676	0.0404511	0.001	0.0005528	0.0010625	0.0016586	0.0013293		
6	0.0067051	0.0040709	0.0073437	0.0505896	0.001	0.0004068	0.0007818	0.0012204	0.0010695		
7	0.0035916	0.0021806	0.0039337	0.0401865	0.001	0.0002819	0.0005419	0.0008459	0.001213		
8	0.0052238	0.0031716	0.0057213	0.0208743	0.001	0.0002281	0.0004383	0.0006843	0.0014515		
9	0.0031257	0.0018978	0.0034234	0.0536903	0.001	0.0004415	0.0008484	0.0013245	0.0011036		
10	0.0051122	0.0031038	0.005599	0.0236625	0.001	0.0005417	0.001041	0.0016251	0.0012135		
11	0.0069708	0.0042323	0.0076347	0.0178756	0.001	0.0012473	0.0023972	0.0037421	0.0014218		
12	0.0039467	0.0023962	0.0043226	0.0261195	0.001	0.0005519	0.0010607	0.0016557	0.0011302		

EPA Fuel Economy Estimates (miles per gallon) from year 1983 to 2007 for the 28 vehicle classes

*Vclass	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	21.9	22.2	22.9	23.7	23.8	24.3	23.9	23.6	23.8
2	18.9	18.6	18.7	19.6	19.7	19.3	19.1	18.9	19.4
3	18.9	18.6	18.7	19.6	19.7	19.3	19.1	18.9	19.4
4	14.5	14.3	14.4	15	15.2	14.8	14.7	14.6	14.9
5	14.5	14.3	14.4	15	15.2	14.8	14.7	14.6	14.9
6	8.81	8.91	9.01	9.11	9.22	9.32	9.42	9.52	9.62
7	8.16	8.26	8.35	8.45	8.54	8.63	8.73	8.82	8.92
8	7.87	7.98	8.09	8.21	8.32	8.43	8.55	8.66	8.78
9	7.3	7.35	7.41	7.47	7.52	7.58	7.63	7.68	7.74
10	6.83	6.93	7.03	7.13	7.23	7.33	7.43	7.53	7.63
11	6.54	6.62	6.69	6.76	6.83	6.89	6.96	7.03	7.1
12	6.09	6.17	6.24	6.32	6.39	6.47	6.54	6.62	6.7
13	5.43	5.55	5.64	5.75	5.91	6	6.09	6.19	6.29
14	26.2	30.9	29.1	34.4	25.9	31.8	37.7	32.4	32.4
15	24.7	25	23.8	24.4	23.4	20.3	20.7	22.1	22.1
16	11.13	11.27	11.41	11.55	11.69	11.83	11.97	12.11	12.26
17	10.01	10.14	10.27	10.39	10.52	10.65	10.77	10.9	11.03
18	9.27	9.34	9.41	9.49	9.56	9.63	9.7	9.77	9.85
19	8.78	8.87	8.95	9.04	9.12	9.21	9.29	9.38	9.46
20	7.96	8.02	8.08	8.14	8.2	8.25	8.31	8.37	8.42
21	7.38	7.39	7.4	7.41	7.43	7.44	7.45	7.46	7.47
22	5.79	5.84	5.9	5.96	5.96	6.03	6.1	6.17	6.24
23	5.16	5.25	5.33	5.42	5.51	5.59	5.68	5.77	5.86
24	50	50	50	50	50	50	50	50	50
25	6.18	6.18	6.18	6.18	6.18	6.21	6.24	6.27	6.3
26	3.94	3.94	3.94	3.94	3.94	3.99	4.04	4.08	4.13
27	6.29	6.29	6.29	6.29	6.29	6.28	6.27	6.25	6.24
28	19	19.3	18.3	18.8	18	15.6	15.9	17	17

Please note that the real EPA table is from 1952 to 2050.

continuation

*Vclass	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	23.5	24	23.9	24.1	24.1	24.2	24.3	24	24.1
2	19	19.1	18.9	18.7	19	18.8	19	18.7	18.7
3	19	19.1	18.9	18.7	19	18.8	19	18.7	18.7
4	14.6	14.7	14.6	14.4	14.6	14.5	14.6	14.4	14.4
5	14.6	14.7	14.6	14.4	14.6	14.5	14.6	14.4	14.4
6	9.73	9.83	9.93	10.03	10.13	10.13	10.13	10.13	10.13
7	9.01	9.11	9.2	9.3	9.39	9.39	9.39	9.39	9.39
8	8.89	9.01	9.12	9.24	9.35	9.35	9.35	9.35	9.35
9	7.79	7.85	7.9	7.95	8.01	8.01	8.01	8.01	8.01
10	7.73	7.84	7.94	8.04	8.14	8.14	8.14	8.14	8.14
11	7.17	7.24	7.31	7.38	7.45	7.45	7.45	7.45	7.45
12	6.77	6.85	6.92	7	7.07	7.07	7.07	7.07	7.07
13	6.38	6.47	6.57	6.67	6.76	6.76	6.76	6.76	6.76
14	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4
15	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1
16	12.4	12.54	12.68	12.82	12.96	12.96	12.96	12.96	12.96
17	11.15	11.28	11.41	11.53	11.66	11.66	11.66	11.66	11.66
18	9.92	9.99	10.06	10.13	10.2	10.2	10.2	10.2	10.2
19	9.54	9.63	9.71	9.8	9.88	9.88	9.88	9.88	9.88
20	8.48	8.54	8.59	8.65	8.71	8.71	8.71	8.71	8.71
21	7.48	7.49	7.51	7.52	7.53	7.53	7.53	7.53	7.53
22	6.31	6.38	6.45	6.52	6.59	6.59	6.59	6.59	6.59
23	5.95	6.03	6.12	6.21	6.3	6.3	6.3	6.3	6.3
24	50	50	50	50	50	50	50	50	50
25	6.33	6.37	6.4	6.42	6.45	6.45	6.45	6.45	6.45
26	4.17	4.22	4.26	4.31	4.36	4.36	4.36	4.36	4.36
27	6.23	6.22	6.2	6.19	6.18	6.18	6.18	6.18	6.18
28	17	17	17	17	17	17	17	17	17

continuation

*Vclass		2001	2002	2003	2004	2005	2006	2007
1		24.1	24.1	24.1	24.1	24.1	24.1	24.1
2		18.5	18.5	18.5	18.5	18.5	18.5	18.5
3		18.5	18.5	18.5	18.5	18.5	18.5	18.5
4		14.2	14.2	14.2	14.2	14.2	14.2	14.2
5		14.2	14.2	14.2	14.2	14.2	14.2	14.2
6		10.13	10.13	10.13	10.13	10.13	10.13	10.13
7		9.39	9.39	9.39	9.39	9.39	9.39	9.39
8		9.35	9.35	9.35	9.35	9.35	9.35	9.35
9		8.01	8.01	8.01	8.01	8.01	8.01	8.01
10		8.14	8.14	8.14	8.14	8.14	8.14	8.14
11		7.45	7.45	7.45	7.45	7.45	7.45	7.45
12		7.07	7.07	7.07	7.07	7.07	7.07	7.07
13		6.76	6.76	6.76	6.76	6.76	6.76	6.76
14		32.4	32.4	32.4	32.4	32.4	32.4	32.4
15		22.1	22.1	22.1	22.1	22.1	22.1	22.1
16		12.96	12.96	12.96	12.96	12.96	12.96	12.96
17		11.66	11.66	11.66	11.66	11.66	11.66	11.66
18		10.2	10.2	10.2	10.2	10.2	10.2	10.2
19		9.88	9.88	9.88	9.88	9.88	9.88	9.88
20		8.71	8.71	8.71	8.71	8.71	8.71	8.71
21		7.53	7.53	7.53	7.53	7.53	7.53	7.53
22		6.59	6.59	6.59	6.59	6.59	6.59	6.59
23		6.3	6.3	6.3	6.3	6.3	6.3	6.3
24		50	50	50	50	50	50	50
25		6.45	6.45	6.45	6.45	6.45	6.45	6.45
26		4.36	4.36	4.36	4.36	4.36	4.36	4.36
27		6.18	6.18	6.18	6.18	6.18	6.18	6.18
28		17	17	17	17	17	17	17